DOCUMENT RESUME

ED 355 101 SE 053 307

TITLE	Energy: Multidisciplinary Activities for the Classroom. Top Hit Energy Lesson Plans, K-1, 2-6.
INSTITUTION	National Energy Foundation, Salt Lake City, UT.
PUB DATE	86
NOTE	168p.
AVAILABLE FROM	National Energy Foundation, 5160 Wiley Post Way, Suite 200, Salt Lake City, UT 84116.
PUB TYPE	Guides - Classroom Use - Teaching Guides (For Teacher) (052)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Class Activities; Conservation Education; Elementary Education; *Energy; Energy Conservation; Energy Education; Environmental Education; Instructional Materials; *Learning Activities; *Lesson Plans; Natural Resources; Primary Education; *Teaching Methods
IDENTIFIERS	*Environmental Impact

ABSTRACT

This six-volume set of multidisciplinary instructional materials developed by the National Energy Foundation (NEF) presents energy activities for grades K-1, 2-6. The instructional materials are teacher-developed, teacher-tested, and multi-disciplinary. The lesson plans and activities are organized around seven goal areas of a NEF developed conceptual framework: (1) sources of energy; (2) uses and applications of energy; (3) energy forms and conversions; (4) environmental and economic impacts of energy; (5) limits of energy resources and supply; (6) energy future; and (7) energy conservation and management. Each goal is then divided into concepts that are cited as necessary to a fundamental understanding of energy and listed under each concept are simply stated objectives. Included within each of the activities is time and material requirements, implementation procedure, assessment questions, student handout masters, and suggestions for career awareness activities. (MCO)

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ENERGY

Multidisciplinary Activities for the Classroom.

Top Hit Energy Lesson Plans, K-1, 2-6.

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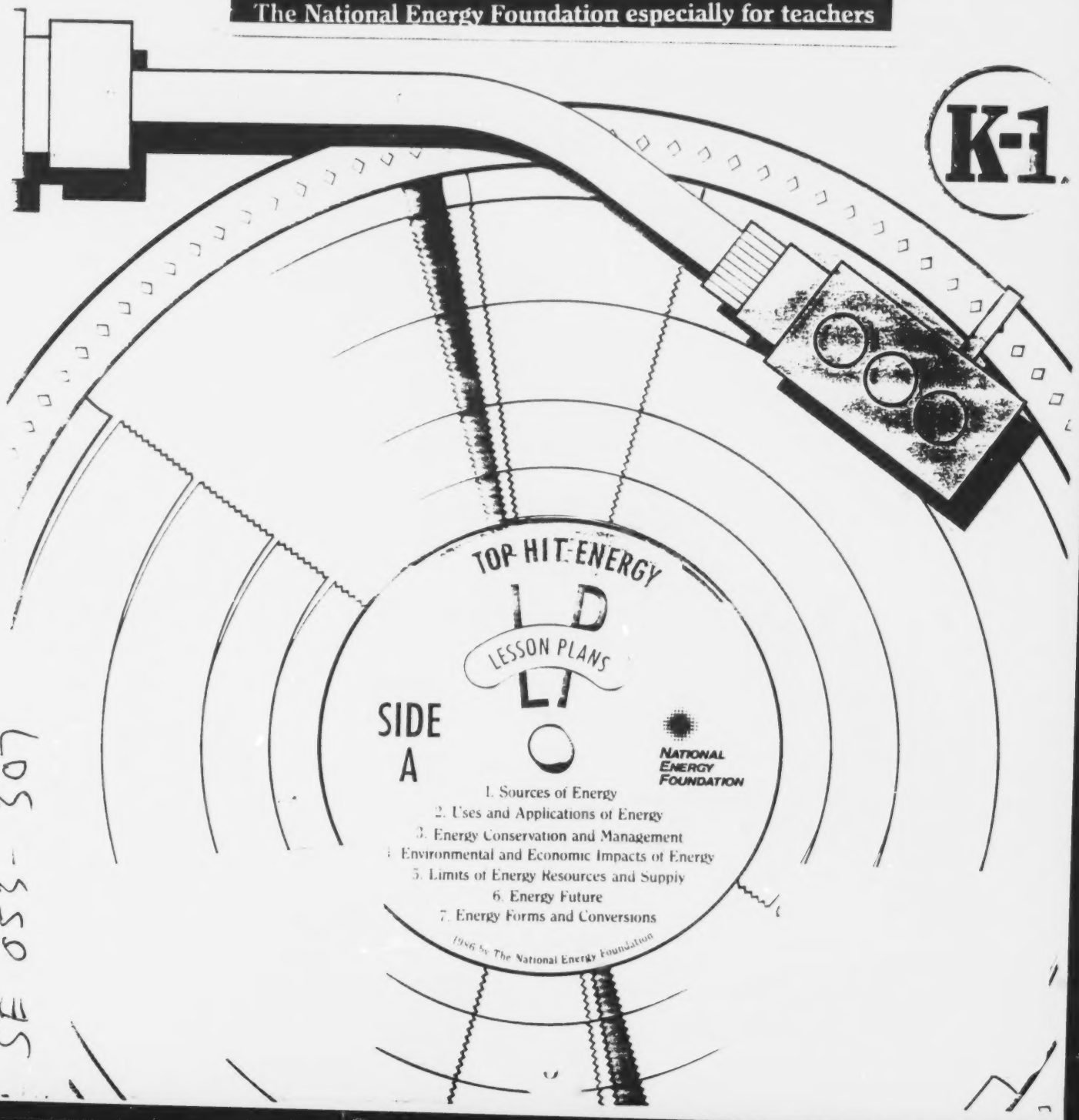
ENERGY

Multidisciplinary activities for the classroom developed by The National Energy Foundation especially for teachers

K-1



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NATIONAL ENERGY FOUNDATION
Resources for Education

About the National Energy Foundation

The National Energy Foundation (NEF) is a unique nonprofit educational organization devoted to the development of instructional materials and teacher and student educational programs dealing with energy. NEF is supported by resources from business, government and education. NEF's primary concern is to present energy, science, technology and contemporary issues accurately and objectively.

To the Teacher

NEF instructional materials are teacher-developed, teacher-tested and multidisciplinary. The instructional materials are developed in accordance with NEF's **Conceptual Framework**. The seven goal areas of the **Conceptional Framework** are: Sources of Energy, Uses and Applications of Energy, Energy Forms and Conversions, Environmental and Economic Impacts of Energy, Limits of Energy Resources and Supply, Energy Future, and Energy Conservation and Management. Each goal area is then divided into concepts which are necessary to a fundamental understanding of energy. Listed under each concept are simply stated objectives.

About the Elementary Lesson Plans

The enclosed elementary lesson plans and activities have been selected as those most preferred by teachers and students. They have been designed for use within NEF implementation workshops. Included within each of the activities is a complete breakdown as to the time needed for implementation, materials required, implementation procedure, assessment questions, student handout masters (for duplication), identification of optional activities or career education suggestions and other information pertaining to the successful completion of the activity.

Warning: some of the activities are potentially hazardous due to the use of flammable substances and/or heat. Please exercise extreme caution. Check your local and state laws governing the use of flammable materials in the classroom. In addition, always be alert to possible electrical hazards. Each school year should begin with a review of the safe use of electricity, and each activity involving the use of electricity should be preceded by a reminder of safety procedures.

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Activity No. 1

Science
Art

sources | grade | time

"The Apple Factory"

K-1 | **60 min.**

Concept
The sun is the primary source of the earth's energy.

Objective
Given the opportunity, the student will draw a food chain beginning with the sun and ending with the child.

Materials
One apple per child
Pots and potting soil
Film: "Legend of Johnny Appleseed"

Implementation

1. Pass out apples, one per child.
2. Discuss: What is a factory? Why are they necessary? What do we get from factories? That factories need energy. Explain to students: How the apple is made. It grows on a tree. The leaves of the tree make the food (function as a factory), and the apple stores the food. To make something, energy is needed. Where does the energy come from to make the apple? The sun. It takes the heat and light from the sun to make the tree grow, and for the leaves to make the food for the apple.
3. Have the students eat their apple and when finished have them plant the seeds. Allow plenty of discussion during eating as to the properties of an apple. Sweet, must contain sugar; tart, pectin; juicy, has water, etc. As the students finish eating their apples, they plant their seeds. Label each pot with the student's name. Place in a sunny window. One or two extra pots may be planted and placed in a dark closet.

   As an art extension, you may wish to have the students draw pictures of their apple as they eat them.
4. Discuss the relative merits of an apple. How do we know that there is food in the apple? How does it taste? How do we feel after eating the apple? Are you still hungry?
5. If possible show the film "Johnny Appleseed" or read the story to the class.
6. Have the students draw a food chain, include the sun, tree, apple, child, and seed.
7. Discuss with students what sources of energy are used to produce electricity (coal, oil, natural gas, nuclear), gasoline (oil), heat (coal, oil, natural gas).

Suggested Career Awareness Activity
Invite a fruit grower (if available) to speak to the class about his/her profession.

Suggested Assessment
Have students draw a food chain for the fruit of their choice.

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Activity No. 2

Science
Art, Language Arts

"Sources of Energy Coloring Book"

sources

grade **K-1**

time **8-30 min.**

Concept
Energy sources can be classified in many different ways.

Objective
Given the Sources of Energy Coloring Book to complete, the student will be able to identify and describe a minimum of four sources of energy.

Materials
Copy of coloring book for each child
Crayons

Implementation
1. Each day, introduce a new source of energy from the coloring book. Read the story.
2. Discuss the source and how it is used, how it is formed, in addition to what the story tells.
3. Have students color the picture.

Suggested Career Awareness Activities
1. Discuss the workers involved directly and indirectly with each source.
2. Invite any parents who work with any of the sources to speak to the class about his/her profession.

Suggested Assessment
Have the student express his/her knowledge of several energy sources in verbal or picture form.

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"SOURCES OF ENERGY COLORING BOOK"

Name _____ Date _____

Food Energy
Food gives our bodies energy.
We need energy from food to
keep us healthy and active.
Food gets its energy
From the sun.

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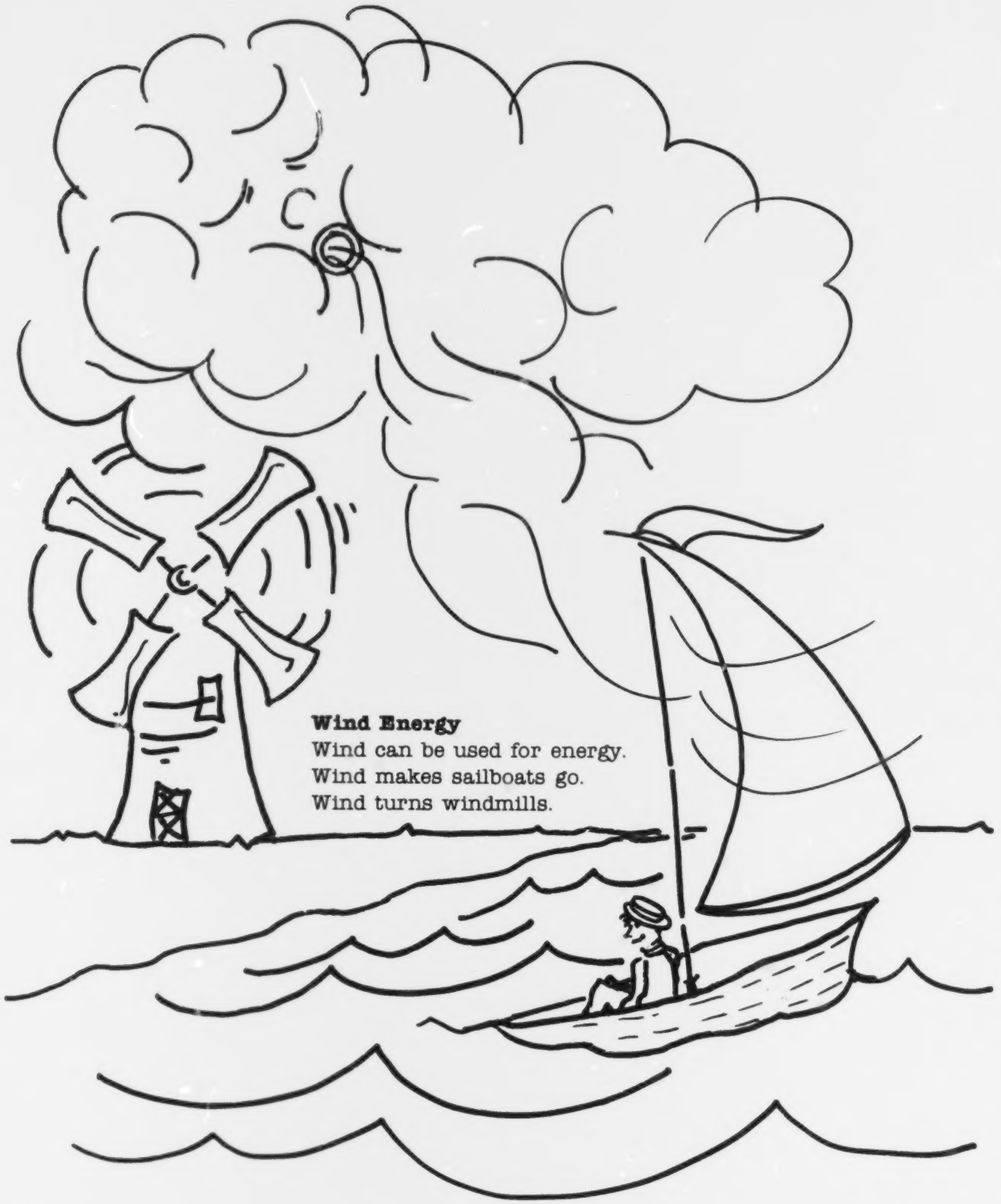

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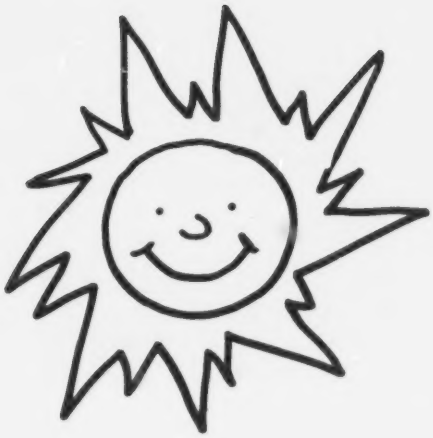
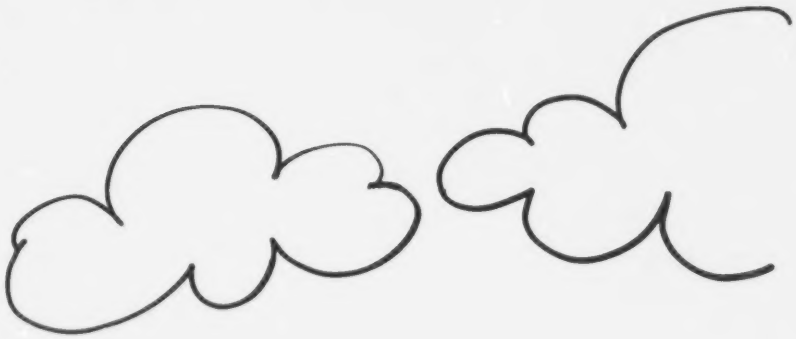
Coal Energy

Big machines scrape the ground to get the coal.

Machines load trucks.

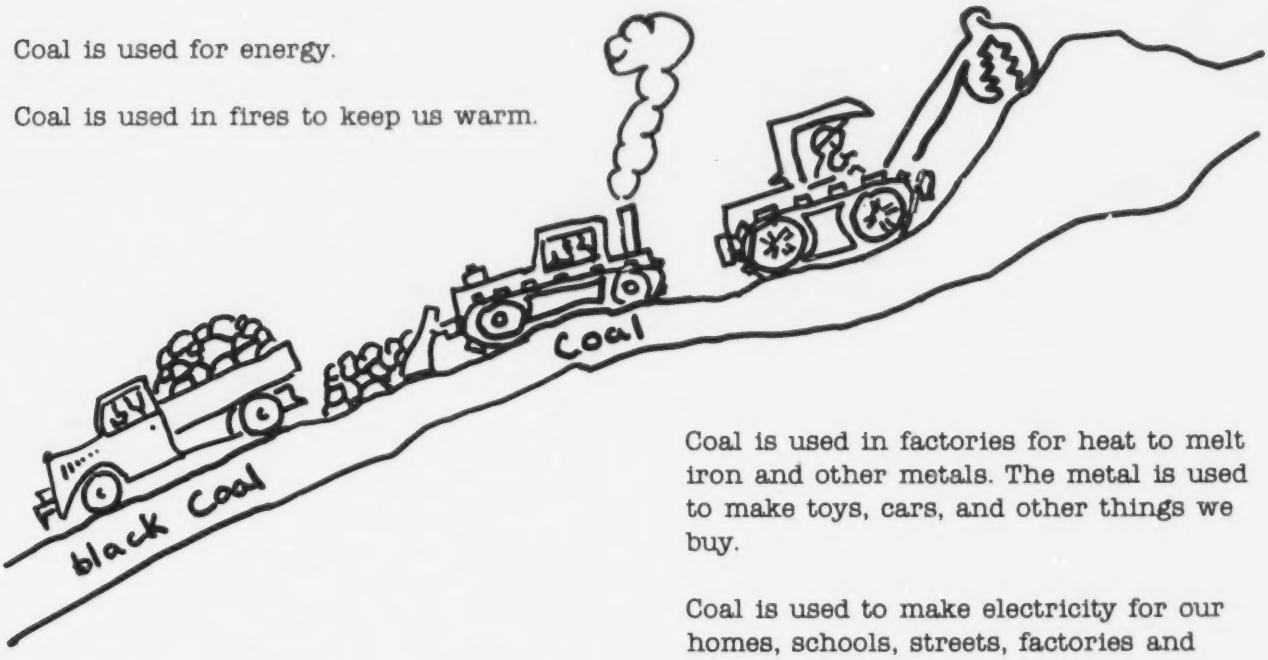
The trucks haul the coal to where it is needed.





Coal is used for energy.

Coal is used in fires to keep us warm.



Coal is used in factories for heat to melt iron and other metals. The metal is used to make toys, cars, and other things we buy.

Coal is used to make electricity for our homes, schools, streets, factories and stores.

Coal was formed a long, long time ago from dead plants that were buried under thousands of feet of earth.

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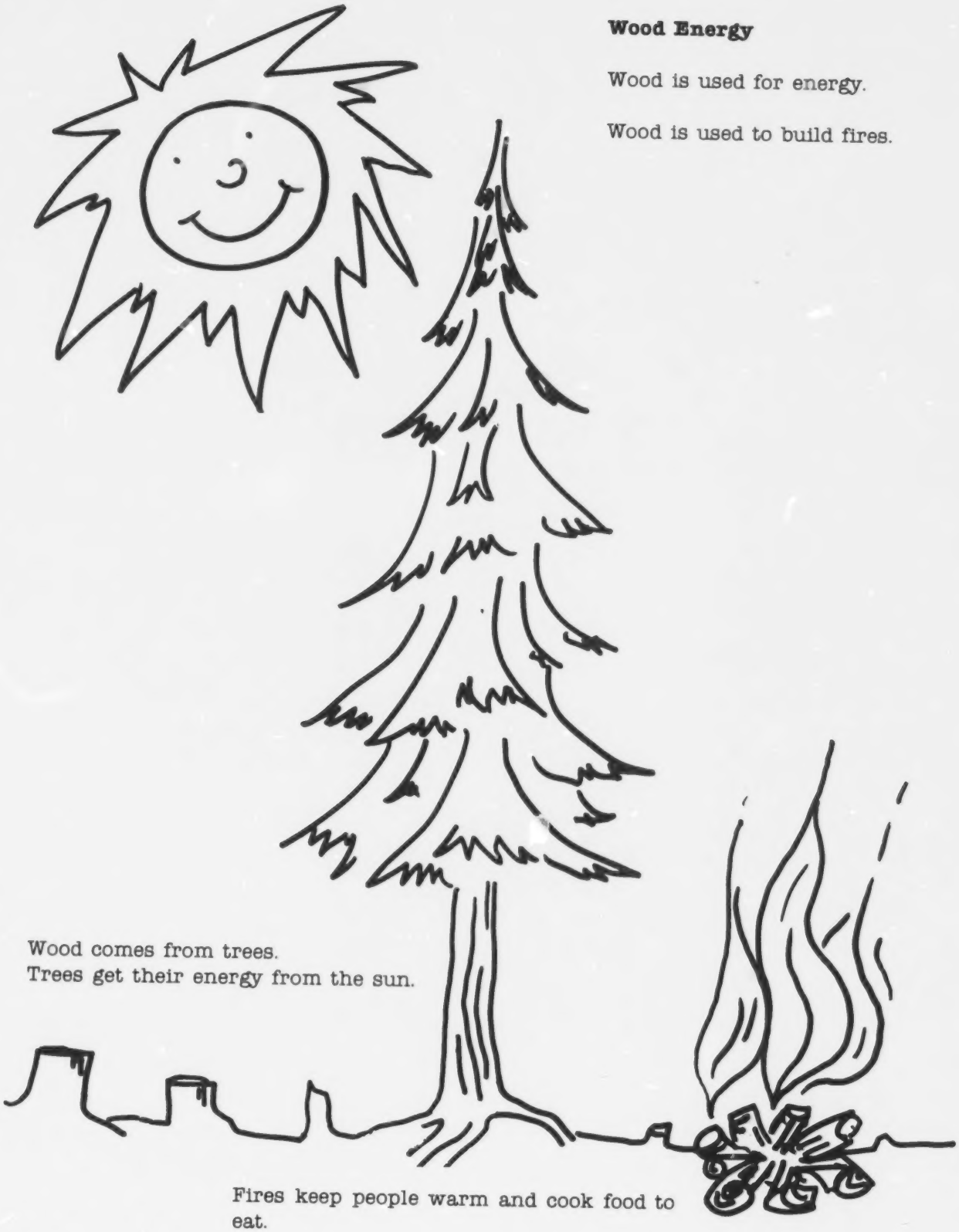
Wood Energy

Wood is used for energy.

Wood is used to build fires.



Wood comes from trees.
Trees get their energy from the sun.

Fires keep people warm and cook food to eat.

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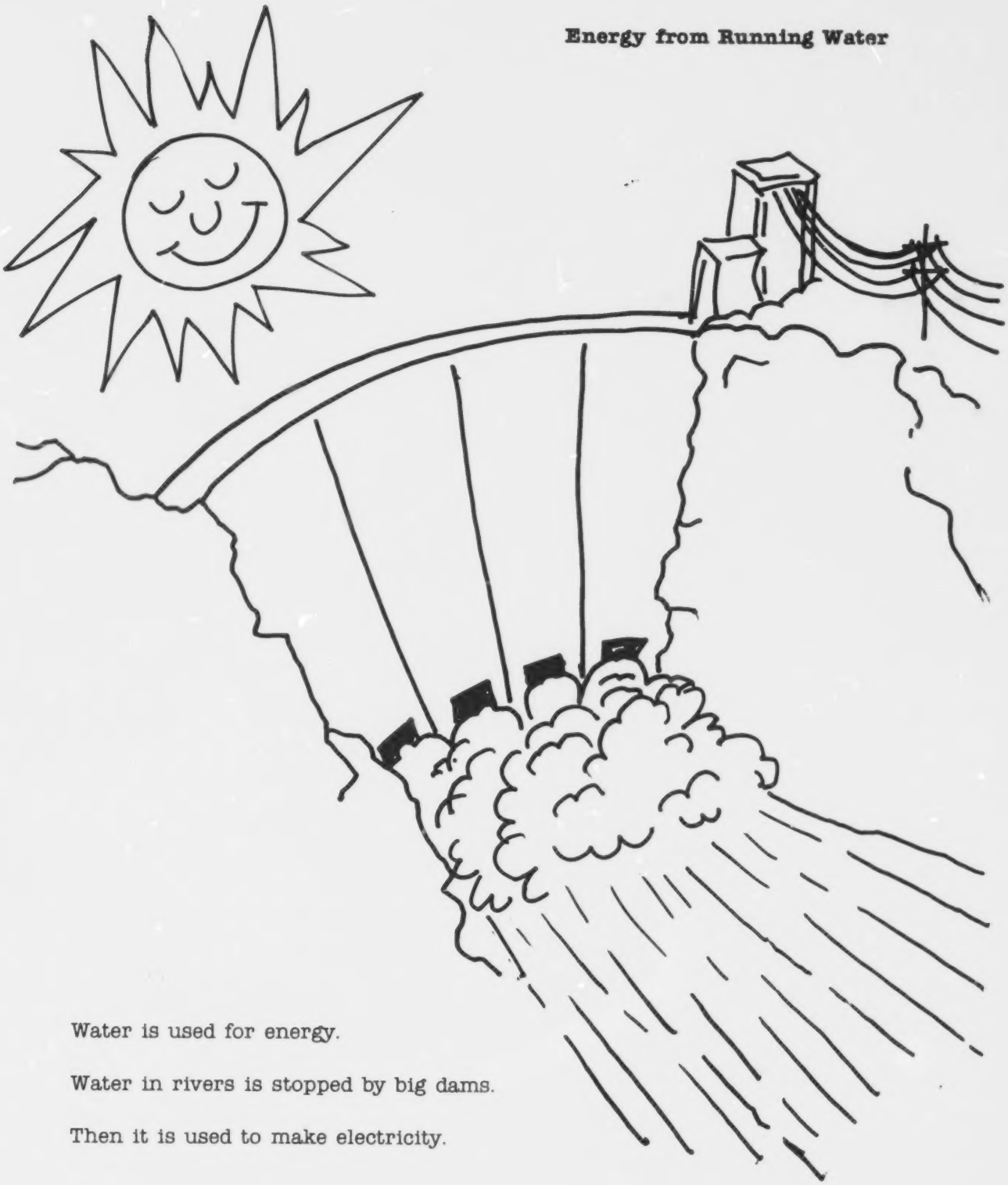
Energy from Running Water



Water is used for energy.

Water in rivers is stopped by big dams.

Then it is used to make electricity.

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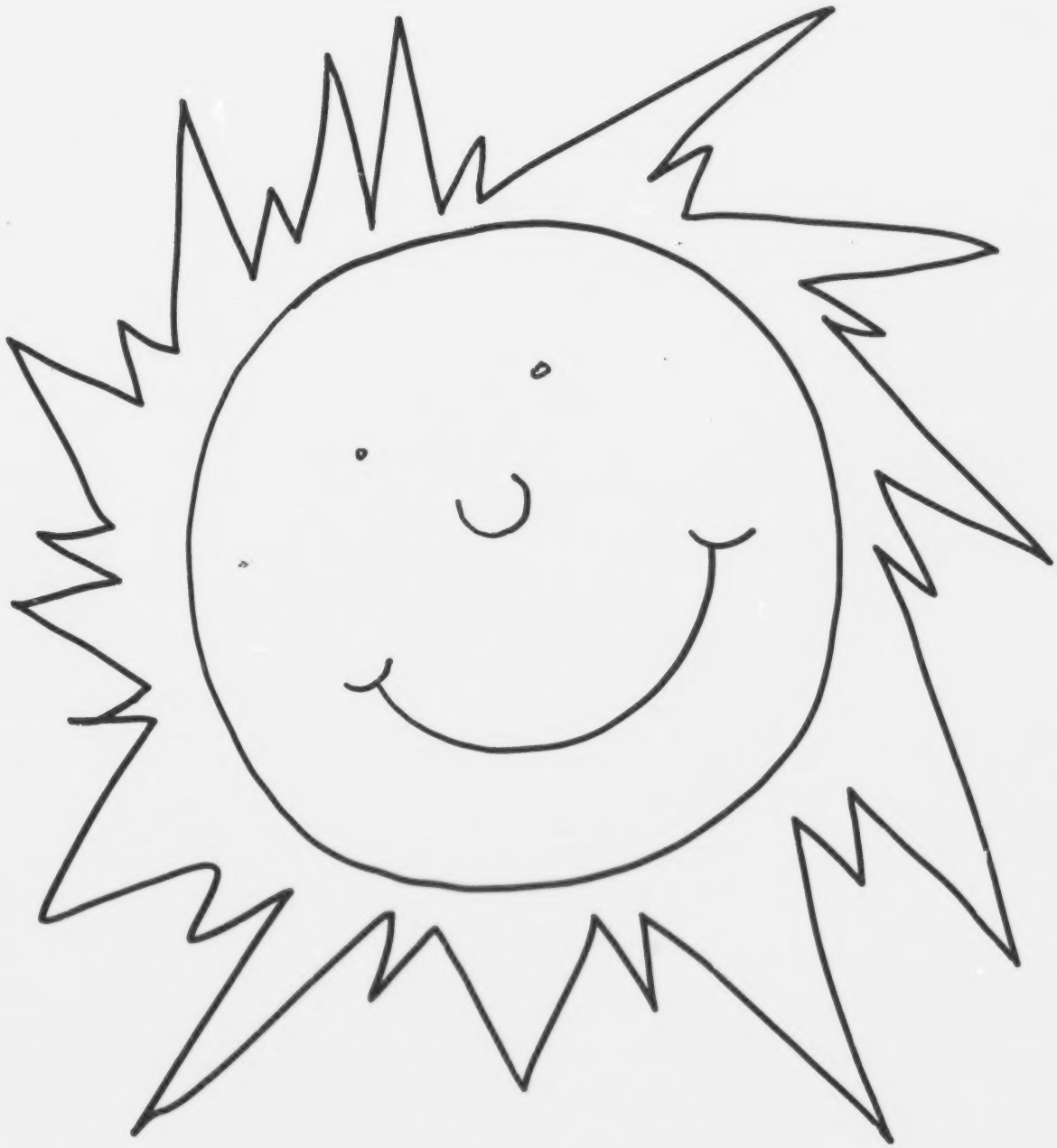
Energy from the Sun



The sun gives plants energy to make food.

The sun gives us light and heat.

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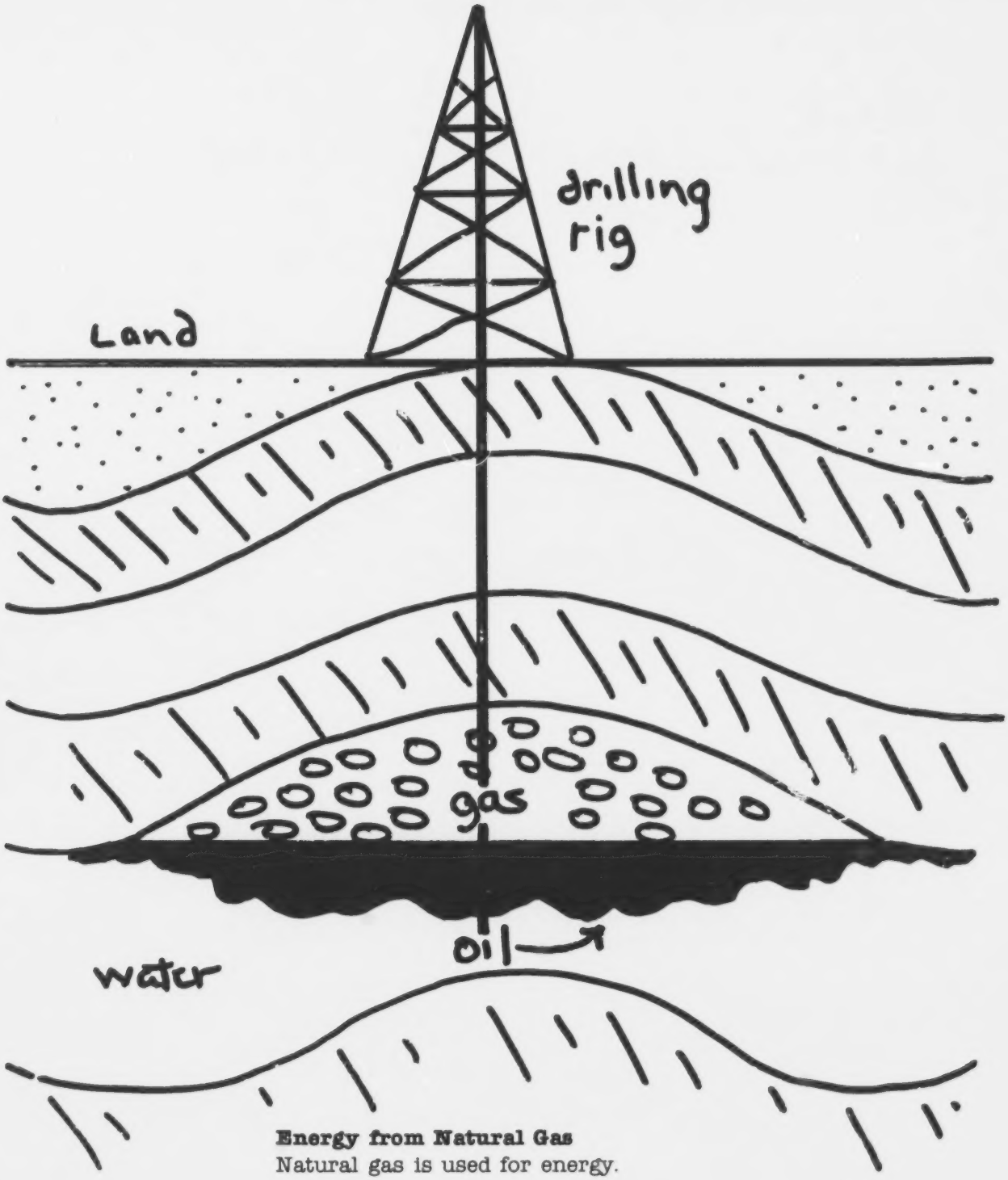

Energy from Natural Gas
Natural gas is used for energy.

Natural gas is burned to make heat.

The heat is used to cook food, or keep us warm.

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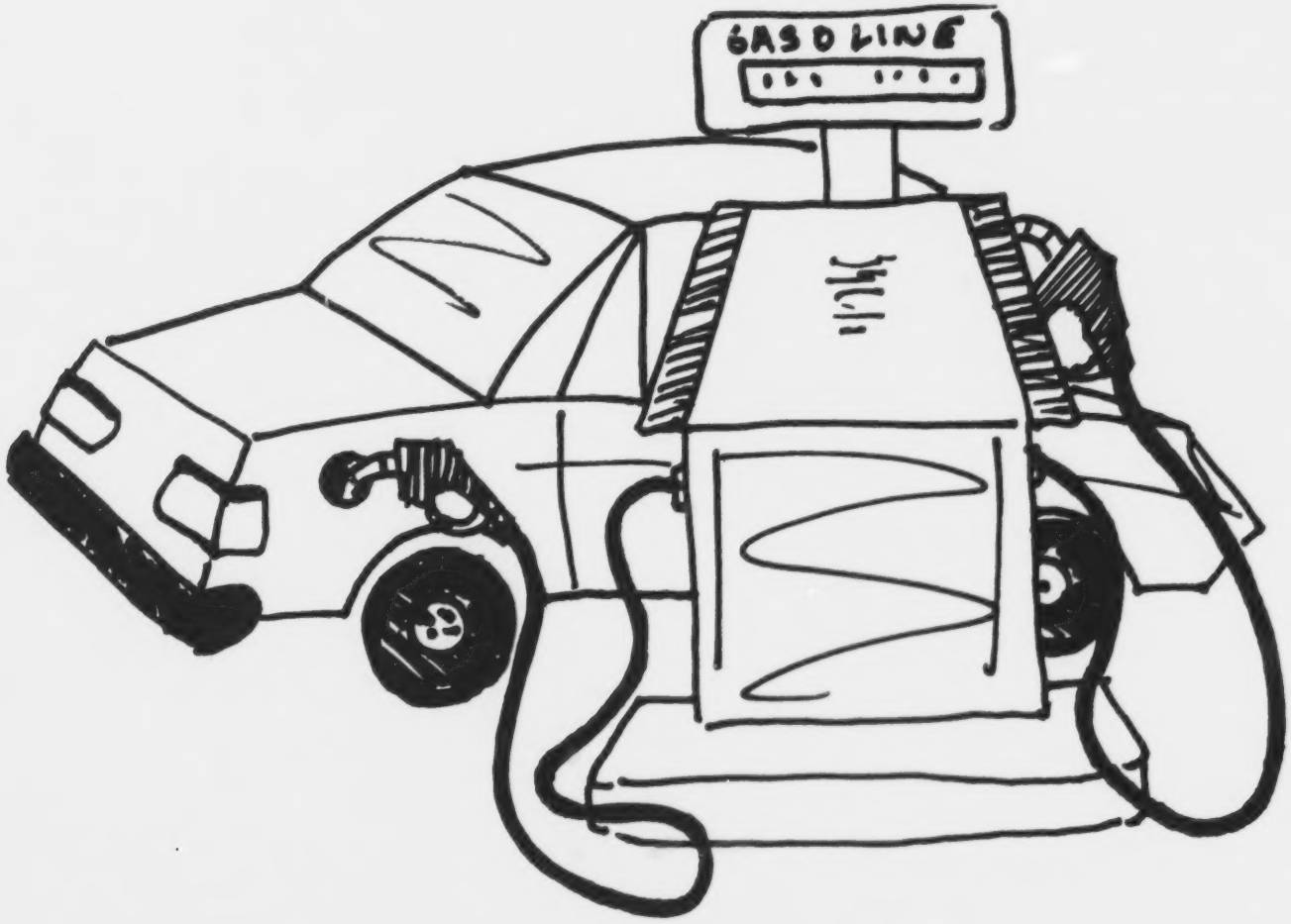
Energy from Oil
Oil is used for energy.

Oil is burned to make heat.

The heat is used to keep us warm.

Oil is used to make electricity.

Oil is also used to make gasoline for cars and trucks.



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Activity No. 3

Science
Language Arts, Art

"Energy Matchword"

sources grade **K-1** time **45 min.**

Concept
Energy sources can be classified in many different ways.

Objective
Given the opportunity to play the energy matchword game using several energy forms, the student will be able to identify several energy forms or sources.

Materials
Student Handout
Cardboard
Rubber cement

Implementation
1. Review with the students the various energy words represented on the student handout pages.
2. Glue the drawings and words to a piece of cardboard. Cut them out and use them to play "Energy Matchword."
3. Rules:
   A. Put the cards face down on a table.
   B. Taking turns, students turn one card up and try to find its match.
   C. If the cards match they may be picked up and kept by that student and he/she is allowed another turn.
4. If the cards do not match they must be turned face down again and the turn moves to another student.
5. The winner is the student with the greatest number of matches.

Note: Difficult words and their matches may be removed for younger or less capable students.

Suggested Assessment
Have students illustrate one of the energy words.

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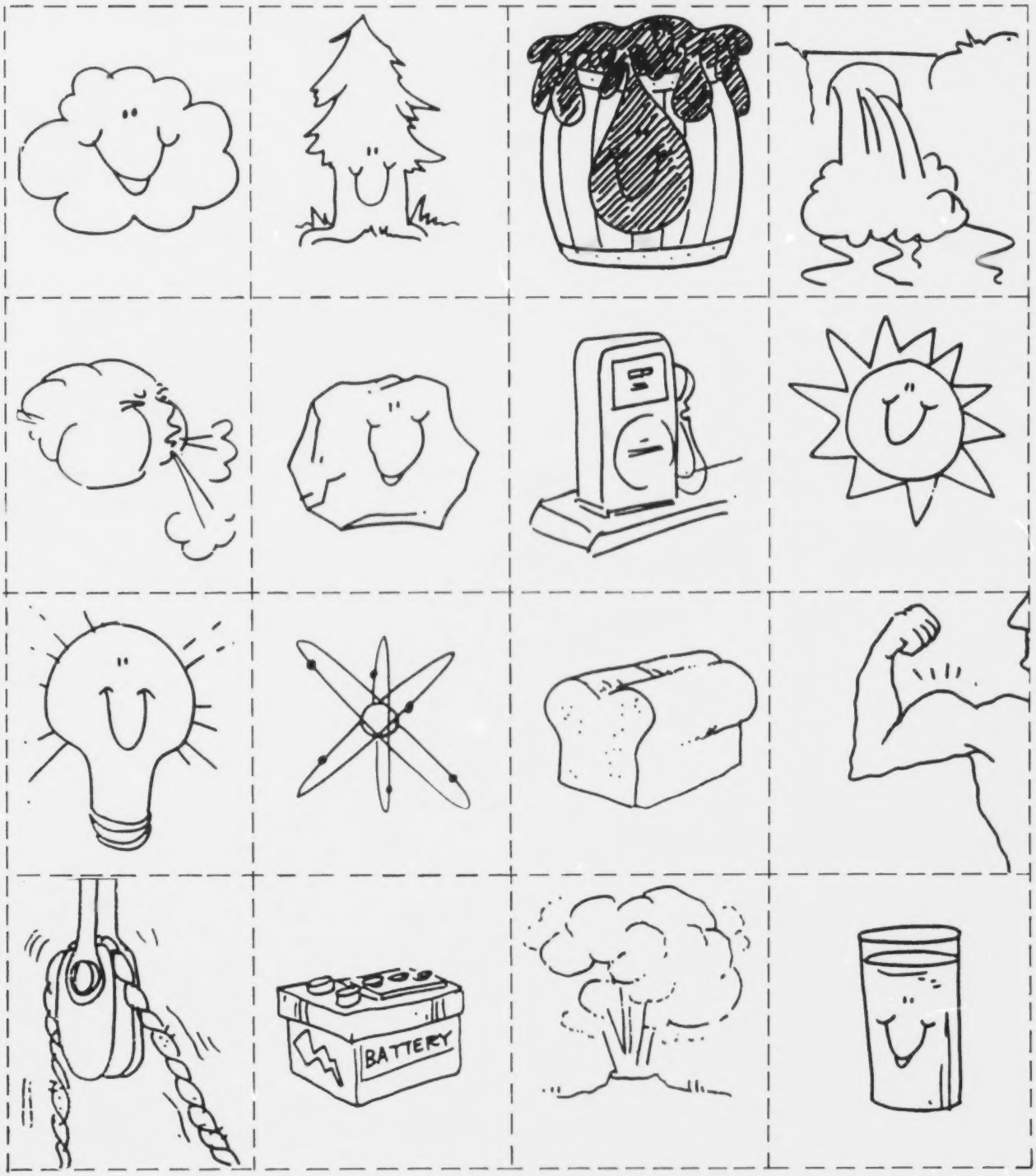
"ENERGY MATCHWORD GAME"



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"ENERGY MATCHWORD GAME"

natural gas	wood	oil	hydroelectric
wind	coal	gasoline	solar
electricity	nuclear	food	muscle
mechanical	chemical	geothermal	water

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Activity No. 4

Science
Art, Language Arts

uses | grade | time

"Where Do I Get My Energy?"

K-1 | **45 min.**

Concept
All living things and other natural processes require energy.

Objective
Given the opportunity, the student will be able to match an energy word to an energy use picture.

Materials
Crayons
Where Do I Get My Energy? Worksheet

Implementation
1. Write the following energy words on the chalkboard and go over each word with the students. Also ask students to suggest ways that the energy can be used.

Gasoline	Food
Sun	Electricity
Wood	Coal
Wind	Natural gas

2. Duplicate the cut and paste word picture match sheet and have students color the energy use picture.
3. Have students cut and paste the energy words to the correct pictures.
4. Discuss the students' answers.

Suggested Assessment
Write the following energy words on the chalkboard and go over with students. Have students illustrate how one of the energy words is used.

Electricity
Oil
Natural gas
Coal

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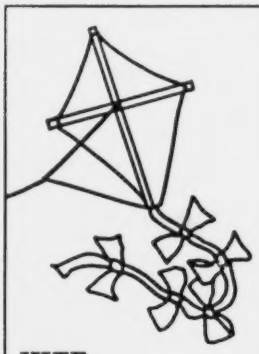
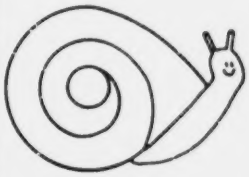
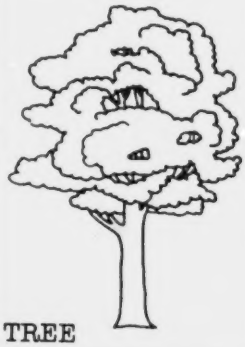
"WHERE DO I GET MY ENERGY?"

Name _____ Date _____

 KITE	LAMP	 SNAIL	CAR
 TREE	FIRE	TELEVISION	BOAT

COLOR THE PICTURES.

GASOLINE	SUN	WIND	ELECTRICITY
WOOD	WIND	ELECTRICITY	FOOD

Directions: Cut and paste, match the word to the picture.

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Activity No. 5

Science

"Move It!"

conversions grade K-1 time 40 min.

Concept
Energy is the capacity to do work.

Objective
Given the opportunity to observe the movements of different objects, the children will be able to determine that it takes energy to move an object, and that energy often is converted from one form to another.

Materials
Ping pong balls
Box
Stick
Blow dryer
Wind-up toy

Implementation

1. Place the ping pong balls in the box. Ask the children to consider all the ways that the balls could be made to move. If possible, try each suggestion and ask where the energy came from.
2. Move by hand. Develop the energy conversion cycle of where the hand energy comes from (human energy, food, solar). If we put food beside the ball, can it move? Or can sunshine move the ball? The energy needs to be converted in order to do work—move the balls.
3. Move balls with a stick. Where did the energy come from? Can the stick move the ball all by itself?
4. Move balls with a blast from a blow dryer. Where did the energy come from?
5. Tip the box. Where did the energy come from?
6. If the ball is placed on a tilted surface, what happens? What energy was working then?
7. Use the wind-up toy. Where does the energy come from?
8. Discuss systems in the room as to their energy source: clock, projector, record player, the school's heating system. Emphasize that in order for work to be done—things to move—energy must be used (converted).

Suggested Assessment
Have students illustrate work.

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Activity No. 6

Science
Art

conversions | grade | time

"Water to Steam"

K-1 | **60 min.**

Concept
There are human made and natural energy conversion systems.

Objective
Given the opportunity, the student will observe an artificial conversion system.

Materials
Tea kettle
Hot plate
Pinwheel
Thermometer
Beaker or can

Implementation

1. Explain to students that one form of energy can be changed (converted) to another. For example, the energy of coal, natural gas, or oil to heat energy. Have the students discuss the meaning of "steam." Name various uses for steam such as steam heat for buildings, steam engines, or the use of steam to produce electricity. Ask students what was converted to make steam?
2. Teacher Demonstration: Using a hot plate, boil water in a tea kettle. As the steam ascends, place a pinwheel in the path of the steam. Discuss that the *heat* energy was used to boil the water to create *steam.* The force of the steam moves the pinwheel.

   A. Discussion:

      1. How long did it take the water to boil?
      2. How long did it take the wheel to begin turning?
      3. How long does it continue turning?
      4. What happens to the heat energy produced by the hot plate?
      5. Is all the steam being used to turn the wheel?
      6. Would the use of steam pollute air, land, or water? Why? Why not?

   B. Using a thermometer, measure the temperature of the steam and boiling water. Could steam be used to heat homes?

3. Discuss with students how heat energy is used to generate electricity.

   "The burning of coal, oil, natural gas, or fission of uranium (nuclear) is used to produce heat energy. The heat energy is then used to turn water into steam. The steam is then used to turn a turbine (a pinwheel-like machine), which spins a generator (made of magnets). The generator produces electricity."

4. Heat a beaker or can of water starting at room temperature. Record the temperature at the end of each minute until the thermometer shows 35°C. Record your data on the chalkboard. Ask students: Is all the heat from the burner going into the water? How do you know? Remove the container of hot water, being sure to use protection to prevent burning. Record the temperature each minute while the water cools to room temperature (as it was before heating). Which took longer, heating or cooling? What do you think is the reason?

Suggested Assessment
Have students make a drawing of the conversion of water to steam.

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Activity No. 7

Science
Social Studies, Art

"The Generous Garbage Collector"

impacts	grade	time
	K-1	2-30 min.

Concept
Energy resource development and use alter environmental conditions.

Objective
Given the opportunity, the student will identify at least three things in his/her home that could be reused which are now wasted.

Materials
9" x 12" drawing paper
Book: *Dear Garbage Man*, Eugene Zion, Scholastic Books, Harper-Row, 1957

Implementation
1. Read *Dear Garbage Man*, a book about a garbage man who goes on a saving spree. He gives things which people throw away to other people who might use them.
2. This book serves as a natural base for the discussion of reuse of materials.
   A. Discuss things that might be reused which are usually thrown away.
   B. Discuss how we can save energy by reusing paper and plastic, and the impact it has on the environment.
3. Have students draw pictures of at least three things that they can reuse.
4. Students will be encouraged to bring items to school for reuse; such as; plastic bottles, magazines, margarine containers, old wrapping paper. Have them make an art project.

Suggested Career Awareness Activity
Invite a garbage collector to come to class to be interviewed about his/her job.

Suggested Assessment
Have students identify three things that can be reused.

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Activity No. 8

Science
Art

limits | grade | time

"How Plants Grow"

K-1 | **3-30 min.**

Concept
All energy resources have limits to their usefulness.

Objective
Given the opportunity, the student will be able to observe how the sun limits the growth of plants.

Materials
2 plants
Drawing paper
Crayons

Implementation

1. Present the class with two plants. Allow discussion as to what the students see: size, kind of plant, color, etc. Inform students that the leaves make food, starch, fat, proteins, vitamins, and other things. Ask: How does this work? Energy from the sun makes the leaf factories work.
2. Discuss with students what would happen to one of these plants if it were put in a dark closet? Do it and find out.
3. One week later:
   A. Take the plant out of the closet and examine. Compare it to the plant that was allowed to remain in the sunny window.
   B. Pass out paper. Direct the students to fold the paper in half. On one half have them write, "This plant was in the closet." On the other half write, "This plant was in the sunny window." Then have the students make an illustration of the two plants.
4. One week later:
   A. Again compare the plants, noting the differences. Ask: What has caused the differences? Allow time for discussion and then have the students illustrate the plants, as before.
   B. Ask: "Students, what has limited the growth of the plant in the closet?"
5. Discuss with students that plants use the sun's energy to grow (make food). Ask students how humans use the energy from coal, oil, or natural gas. How might these energy sources be limited?

Suggested Career Awareness Activity
Visit a nursery to learn about the job of a nursery worker, or invite one to speak to the class.

Suggested Assessment
Have students explain how energy is limiting.

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Activity No. 9

Science
Art

"Energy for the Future"

future grade **K-1** time **60 min.**

Concept
New energy resources may be discovered in the future.

Objective
Given the opportunity, the student will be able to verbalize or illustrate how energy sources are used in the school and a future energy source.

Materials
Drawing paper
Crayons

Implementation
1. Discuss the term "energy." Make a list on the chalkboard of the sources of energy (coal, oil, natural gas) and their uses.
2. Relate the use of energy by the human body: How we acquire, convert, and use food for energy and our dependence on it.
3. Observe all the kinds of energy used at school. Take a walk through the school—possibly with a custodian—to survey energy uses. Include the furnace room, a discussion of the heat source, how many months it is used, what kind of fuel; and energy used in the gym, classrooms, kitchen, and office. Include a bus delivering students to school. Also consider the parking lot full of cars.
4. Discuss with students the advantages and disadvantages of energy used in the school—the way we depend upon it.
5. Have students create an illustration of what would happen if one type of energy was no longer available. Have them include a new, future, energy source to replace the one no longer available.

Suggested Career Awareness Activity
Have students interview the custodian about his/her job after the tour of the building.

Suggested Assessment
Have students indicate what future energy source might be used to replace the use of fossil fuels.

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Activity No. 10

Music
Language Arts, Science

"Let's Sing About Energy"

conservation | grade | time

K-1 | 60 min.

Concept
There are various methods to conserve energy.

Objective
Given the opportunity to use familiar tunes, the student will be able to sing songs with verses about energy conservation and fossil fuels.

Materials
Music and/or record for the songs "Are You Sleeping?" and "Row, Row, Row Your Boat"
Energy lyrics

Implementation

1. Discuss with students the various energy sources and how they are used. List the energy sources and their uses on the chalkboard.
2. Write the word "conservation" on the chalkboard and discuss its meaning with the students. Ask them how they might conserve energy. Write the conservation methods on the chalkboard.
3. "Let's Sing About Energy." Teach each song separately by rote. Songs are included with the lesson.
   A. Play the original song and have students sing along. (Use record or piano accompaniment.)
   B. The teacher sings the first verse with energy lyrics.
   C. The students join the teacher in singing the new lyrics to the first verse.
   D. Follow the same procedure with each new verse and then repeat the whole song to that point.
   E. When the students can sing one song by themselves, teach the other song.
   F. As you teach the energy songs to the students, teach them the pronunciation and meaning of the words.
4. More advanced students may want to sing a "round."
   A. Divide the class into two separate groups or have the students be one group and the teacher sing the second group part.
   B. Have one group start singing the first line of the song. When they have finished the second line in the stanza, have the other group start singing the first line of the song.
   C. The same procedure may be used to sing both songs together at one time as "partner songs."
5. Have the class as a group make up their own lyrics about energy conservation based on the class discussion in Section 2. Record the lyrics on the chalkboard. Have class sing their song.

Suggested Career Awareness Activity
Contrast the energy requirements of rock groups with other entertainers.

Suggested Assessment
Have students illustrate one of the energy songs, depicting energy conservation.

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"LET'S SING ABOUT ENERGY"

I AM TRYING

I am trying, I am trying
Not to waste, not to waste
En-er-gy, en-er-gy,
I can save, you can too.

Fix the faucet, turn off
li-ghts
Close the door, close the door
Insulate and weatherstrip,
insulate and weatherstrip
Help us save, we need you.

Take them ou-t, use them u-p
Waste them too, waste them too
Will our children thank us,
when they're all depleted
Fosill fuels, we'll save you.

Tune—"Are You Sleeping?"

SAVE, SAVE, ENERGY

Save, save, en-er-gy
Every chance you get.
Energy, energy, energy, energy
Will our needs be met?

Homes, schools, factories,
Does it matter whose?
Should not use our fossil fuels
Unwisely or we'll lose.

Oil, coal, natural gas
Precious fossil fuels
Energy, energy, energy, energy
What are we going to use?

Question, think, participate
Your future's in this too.
Energy, energy, energy, energy
What are you going to do?

Tune—"Row, Row, Row Your Boat"

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Activity No. 11

Science
Art

"Eagle-Eye, the Energy-Waster-Eater"

conservation grade **K-1** time **30 min.**

Concept
There are various methods to conserve energy.

Objective
Given the opportunity to depict the role of the Eagle, students use their "eagle eyes" to detect energy wasters and to help remedy the waste by creating reuse of materials.

Materials
Picture or drawing of an eagle
Chart to record findings
Eagle feathers (if not available, create some from paper or cardboard)

Implementation
1. Display a picture of an eagle, and discuss his excellent vision. Tell the students that this eagle is called Eagle Eye, the Energy-Waster-Eater! Eagle Eye can't stand to see our energy wasted. Whenever he sees waste, he stops it and suggests better ways to use our energy.
2. Discuss with students some of the energy wastes he might see. Ask class for suggestions. Responses might include open doors, leaving lights on, partly used papers, piles of "garbage" that might have other uses.
3. Have the children pretend that they are Eagle-Eye and that they are to find energy waste and report it to you. Record their findings on a chart with two columns: 1. Energy Wasted 2. A Better Way. As children have their findings recorded, give them recognition by presenting them with an Eagle-Eye feather. Make the Eagle-Eye feather on tagboard, cardboard, or cereal boxes.
4. After several days of Eagle-Eye role-playing, review all the findings and have an art session on the students' findings.

Suggested Career Awareness Activity
Ask the students what people have jobs that help Eagle-Eye prevent energy waste.

Suggested Assessment
Have each student verbally suggest one way to conserve energy.

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"EAGLE-EYE, THE ENERGY-WASTER-EATER"

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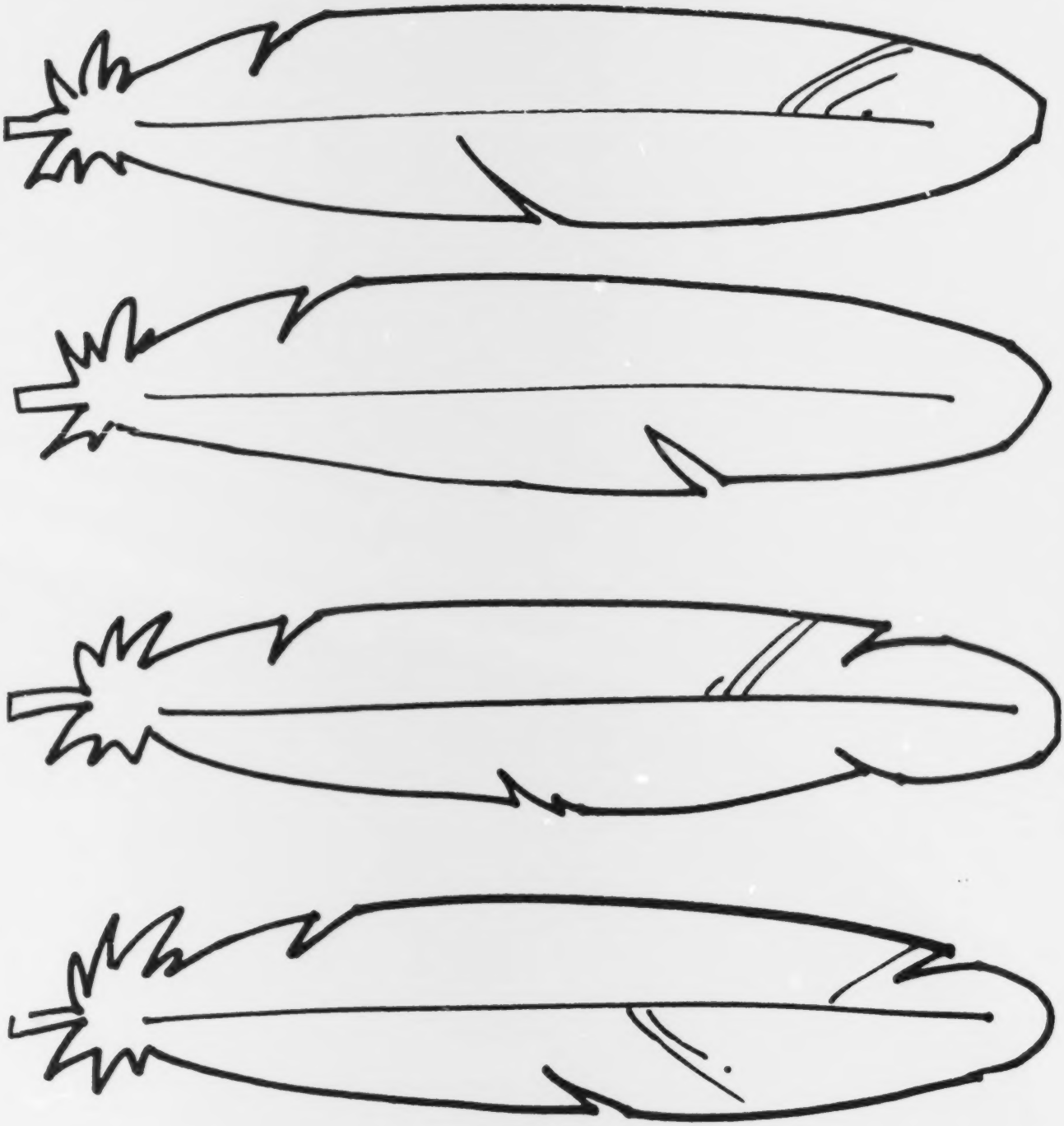
"AWARD FEATHERS"



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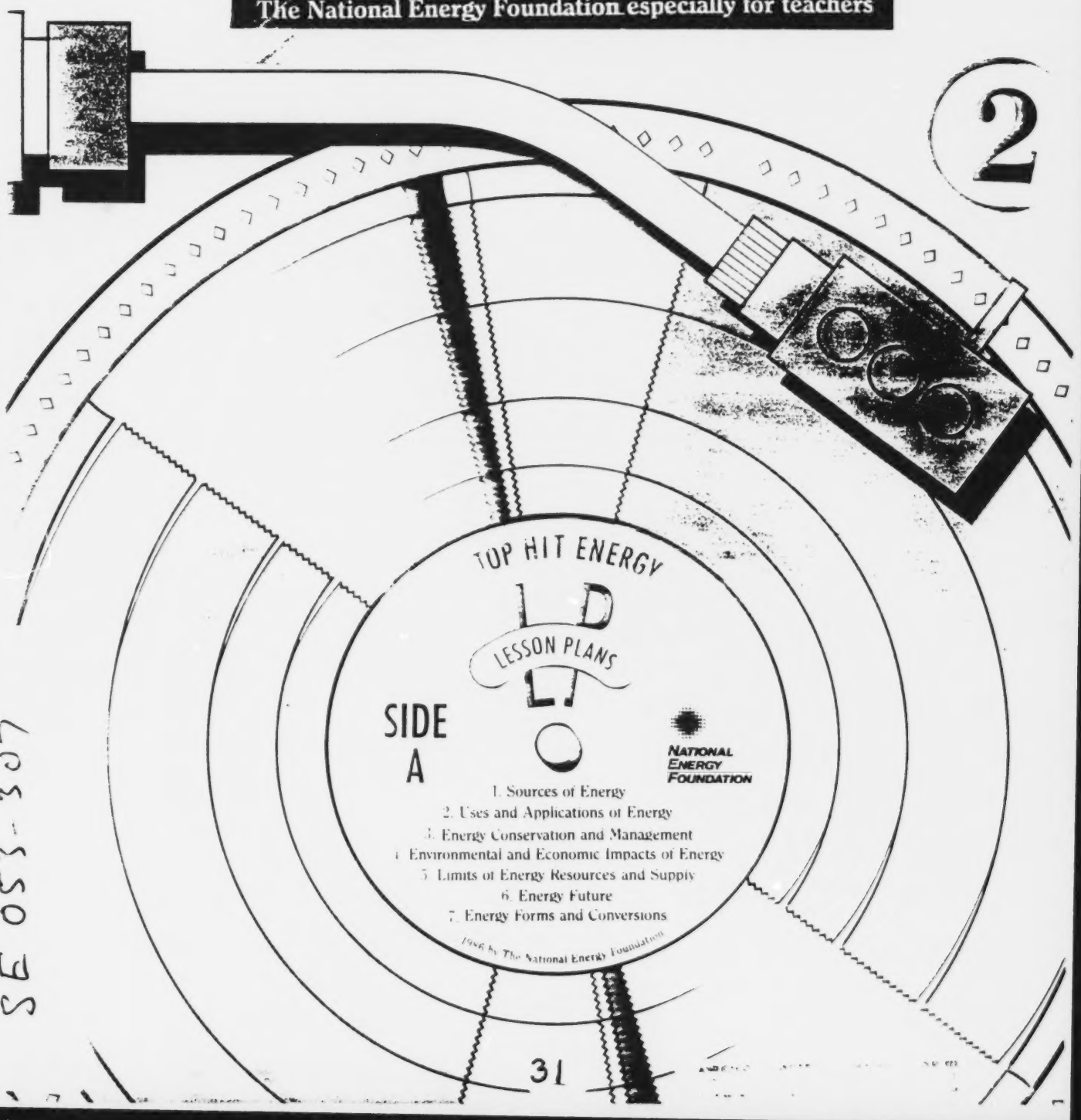
ENERGY

Multidisciplinary activities for the classroom developed by The National Energy Foundation especially for teachers

2



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NATIONAL ENERGY FOUNDATION
Resources for Education

About the National Energy Foundation

The National Energy Foundation (NEF) is a unique nonprofit educational organization devoted to the development of instructional materials and teacher and student educational programs dealing with energy. NEF is supported by resources from business, government and education. NEF's primary concern is to present energy, science, technology and contemporary issues accurately and objectively.

To the Teacher

NEF instructional materials are teacher-developed, teacher-tested and multidisciplinary. The instructional materials are developed in accordance with NEF's **Conceptual Framework**. The seven goal areas of the **Conceptional Framework** are: Sources of Energy, Uses and Applications of Energy, Energy Forms and Conversions, Environmental and Economic Impacts of Energy, Limits of Energy Resources and Supply, Energy Future, and Energy Conservation and Management. Each goal area is then divided into concepts which are necessary to a fundamental understanding of energy. Listed under each concept are simply stated objectives.

About the Elementary Lesson Plans

The enclosed elementary lesson plans and activities have been selected as those most preferred by teachers and students. They have been designed for use within NEF implementation workshops. Included within each of the activities is a complete breakdown as to the time needed for implementation, materials required, implementation procedure, assessment questions, student handout masters (for duplication), identification of optional activities or career education suggestions and other information pertaining to the successful completion of the activity.

Warning: some of the activities are potentially hazardous due to the use of flammable substances and/or heat. Please exercise extreme caution. Check your local and state laws governing the use of flammable materials in the classroom. In addition, always be alert to possible electrical hazards. Each school year should begin with a review of the safe use of electricity, and each activity involving the use of electricity should be preceded by a reminder of safety procedures.

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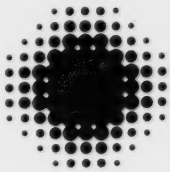

NATIONAL ENERGY FOUNDATION

Resources for Education

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Activity No. 1

Science
Art

"Let's Learn About Different Energy Sources!"

sources grade **2** time **2-45 min.**

Concept
Energy sources can be classified in many different ways.

Objective
Given the opportunity, the student will be able to identify at least four energy sources through sensory experiences.

Materials

- Coal
- Oil
- Gasoline
- Kerosene
- Water
- Wood
- Food
- Electrical appliances
- Drawing paper
- Magazines
- Barbecue
- Pinwheel
- Fan
- Plants
- Felt tip markers
- Art supplies
- Kerosene lamp or camping lantern
- Containers to hold fuel sources

Implementation

1. Tell the students that they will explore some things that supply us with energy.

   Ask students, "what do you know about energy and how is it used at home and school?" "Why do we need energy?" List responses on chalkboard.

2. Have students observe various energy sources, using the appropriate senses of touch, smell and sight. The teacher needs to assemble samples of the following energy sources:
   1. Coal
   2. Oil
   3. Gasoline
   4. Kerosene
   5. Falling water (faucet)
   6. Wood
   7. Food (apple)
   8. Wind (fan, outdoor wind)

   During the activity have students compare samples in terms of texture, smell, size, color, and other properties. Ask students how they are alike. How are they different?

   Record the students' observations on the chalkboard. Discuss the energy sources. Explain that they are samples of things used by people as sources of power to run machines, heat buildings and to provide food.

3. How are the energy sources used to release energy? List student responses on the chalkboard; discuss comments or questions.

4. The teacher demonstrates some of the energy which may be released from various energy sources. Ask the students to make observations. Remind the students that the energy from a source might take the form of heat, light, sound, electricity or movement.

   A. *Coal.* The teacher should set up a barbecue or hibachi outdoors if possible, ignite the coal, and when it is burning have students observe its appearance.

   B. *Oil.* If your school has an oil furnace ask the custodian to take the children on a tour of the furnace room. Some students may also live in homes heated by oil furnaces and might make limited observations under parental supervision.

   C. *Kerosene.* Bring a camping lantern or lamp to class and show how it works. Observe forms in which energy is released.

   D. *Sunlight.*
      1. Have students record, from experience and from indirect observation, the amount of heat and light released by the sun. Discuss the term "solar energy" and how people can use it.
      2. Grow plants in containers; put several in a dark place for at least a week (watering as needed). Keep the remainder in good light conditions. After a week or two has elapsed, compare the two sets of plants. Discuss the needs of plants for light energy.

   E. *Food (nutrition).* After eating lunch, point out that food gives us energy to be active. Without adequate food we would be less active and eventually may become weak or sick.

   F. *Wind.* Using a fan or natural wind, observe the turning of a pinwheel. Relate that in this case moving air is the energy source—one also used to move a sailboat.

   G. *Wood.* Using a barbecue grill, burn some wood. Discuss the energy released from the wood. What happens to the wood?

   H. *Electricity.* Using a wall outlet, demonstrate to students the heat released from an iron or hot plate, light from light bulbs, and using energy from a food (hand) mixer. Using a flashlight or a toy demonstrates energy from batteries. Inform students that electricity is a form of energy.

      Show the films *Energy and Power* and *We Use Power.*

5. Have students color the energy source flash cards.

Suggested Assessment
Using the energy source flash cards, have students name the energy source depicted on the flash cards.

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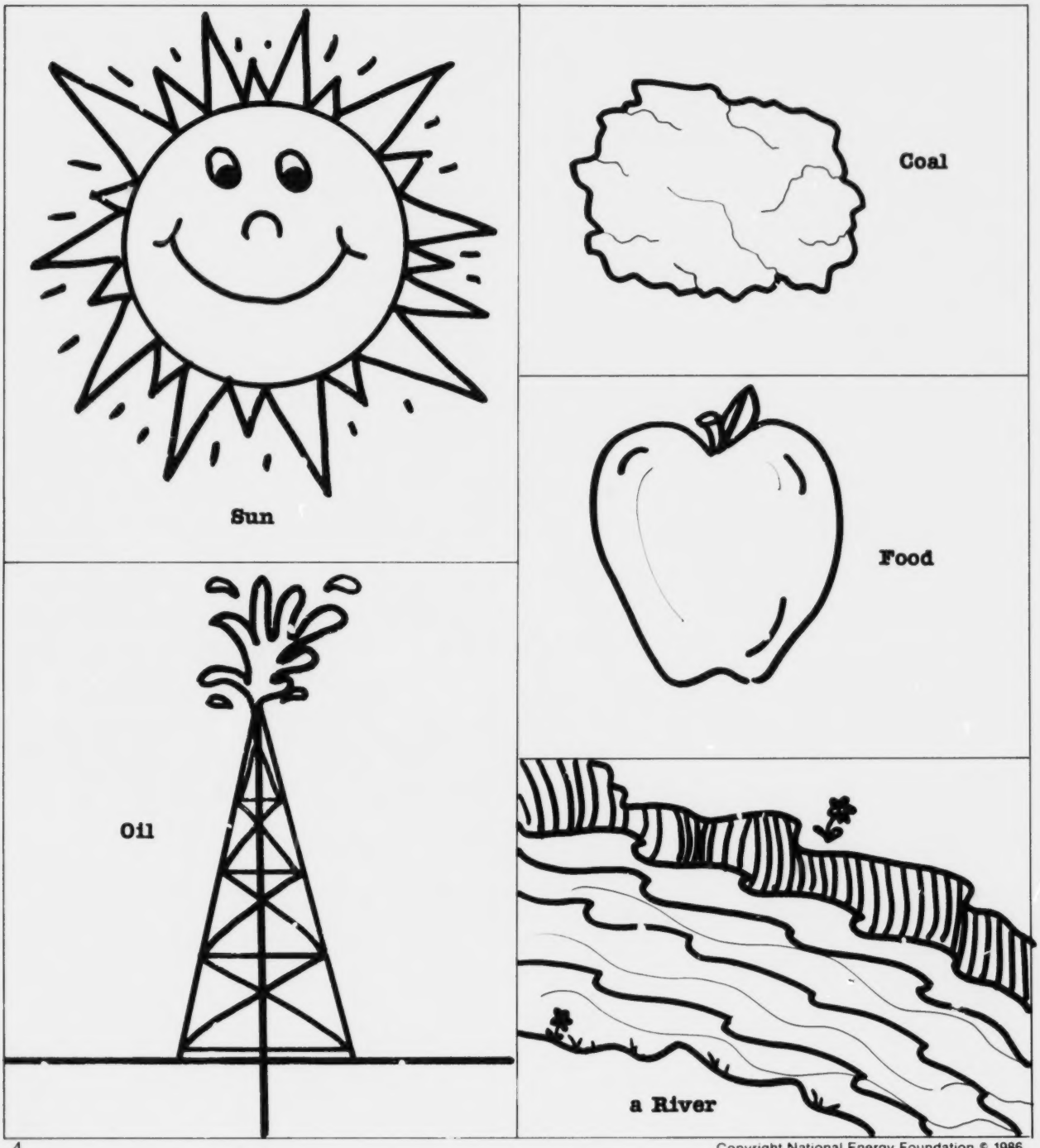
"LET'S LEARN ABOUT DIFFERENT ENERGY SOURCES!"

Name _____ Date _____



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"LET'S LEARN ABOUT DIFFERENT ENERGY SOURCES!"

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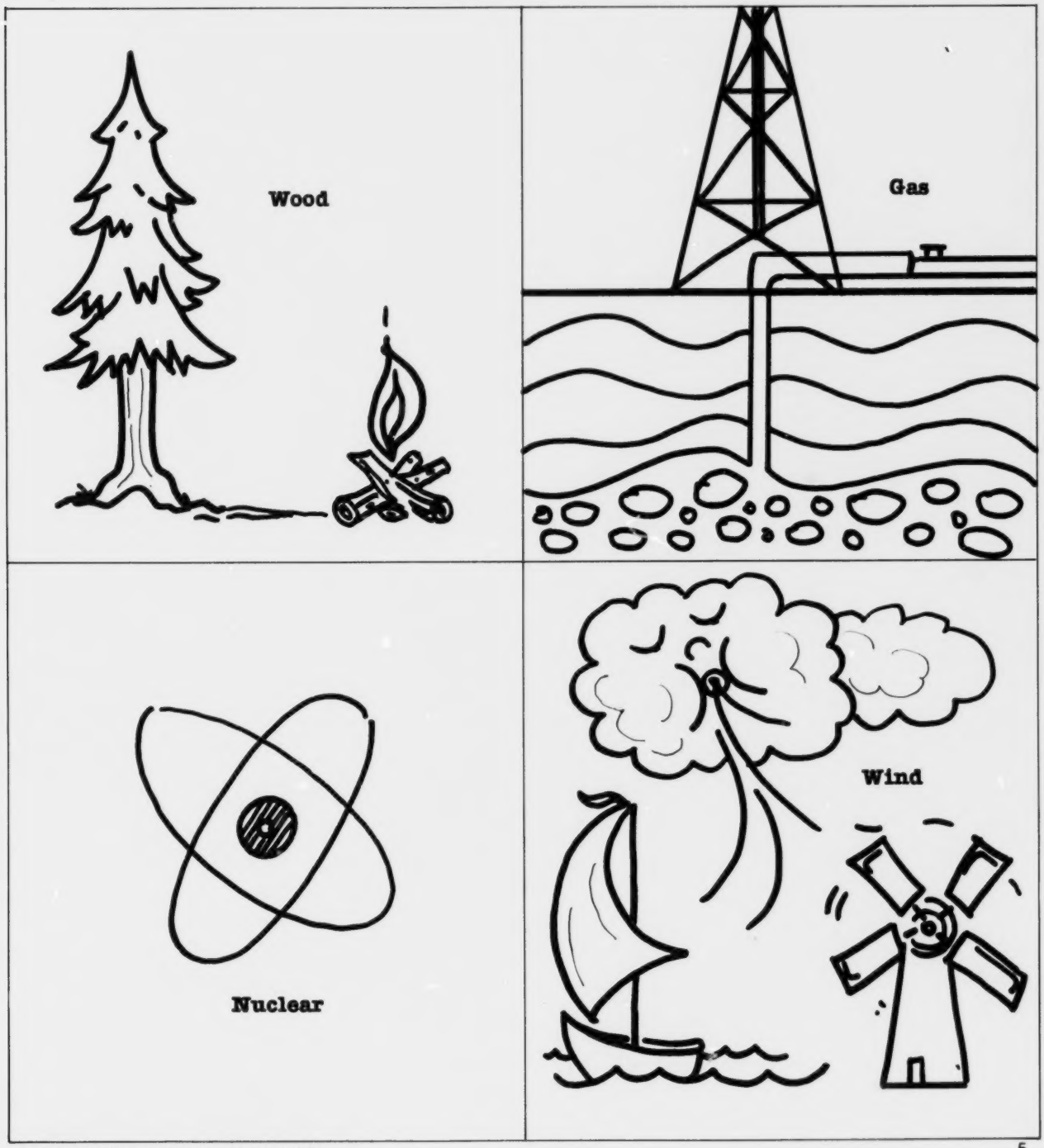

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Activity No. 2

Science
Art

"An Ancient Sandwich"

sources grade **2** time **45 min.**

Concept
Natural and human processes are constantly forming energy resources.

Objective
Given the opportunity to listen to a book about natural gas and oil formation, students will be able to understand the biological, chemical and geological method of formation of natural gas and oil.

Materials
Oil and Gas—From Fossils to Fuels, Harcourt, Brace, Jovanovich, New York, 1977
Several slices of bread
Peanut butter
Jelly
Knife
Paper towels
Wax paper

Implementation

1. Read to the students the book: *Oil and Gas—From Fossils to Fuels.*
2. Ask the students to describe how fossils are changed into oil and natural gas, and how they are stored through time.
3. Using bread, peanut butter and jelly, demonstrate an "ancient sandwich." These sandwiches will be made three ways:
   A. Spread peanut butter (thick) and jelly (thick) on a slice of bread and cover it with a slice of bread.
   B. Spread only peanut butter on a slice and cover it with another slice of bread.
   C. Spread only jelly (thick) on a slice of bread and cover it with another slice.
4. Turn sandwiches "A" and "B" so the peanut butter layer is next to the top slice of bread. With some wax paper firmly press the top slice down onto the sandwich. Cut the sandwiches in half, so students can observe what happened in the middle of the sandwiches.
5. Ask the students to observe what has happened to the jelly in each sandwich. Have them imagine that the jelly layer is the fossil fuel layer, the peanut butter is a rock layer and the bread is another rock layer. Point out that when you pressed on the sandwich it represented pressure of millions of years.

   Questions for Discussion:

   A. In which sandwich(s) did the jelly (fossil fuel) escape?
   B. Were there seepages of jelly when there was nonporous (peanut butter) rock present?
   C. What happened to the ancient supplies of natural gas or oil that did not have a nonporous layer of rock covering it?
   D. Ask the students to brainstorm ways they could remove only the jelly layer from a sandwich.
   E. Have the students decide what you should do with the sandwiches.

Suggested Assessment
Have students make a picture of the formation, and trapping of oil and natural gas in the earth.

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Activity No. 3

Science
Art

"Natural Gas Formation"

sources grade **2** time **30 min.**

Concept
Natural and human processes are constantly forming energy resources.

Objective
When given a worksheet, the student will infer processes by which natural gas was made by viewing a picture sequence that depicts what scientists think happened.

Materials
Worksheet (Student Handout)

Implementation
1. Distribute the student worksheet or make an overhead.
2. Indicate that the worksheet tells a story of how scientists think natural gas was formed. Using the pictures as a guide, have students describe how they think natural gas was formed. Be sure and discuss: How oil and natural gas are formed. What porous and nonporous rocks are. That oil and natural gas float on top of water.

   Optional: Students may wish to construct a clay model of natural gas deposits.

Suggested Assessment
Read the following statements, have students indicate on a piece of paper whether they are true or false.

1. Oil and natural gas were formed from tiny dead plants and animals.
2. Porous rock keeps oil and natural gas from escaping to the surface.
3. It takes millions of years to form oil and natural gas.
4. Oil and natural gas are often found on top of water deep within the earth.

Answers
1-T, 2-F, 3-T, 4-T

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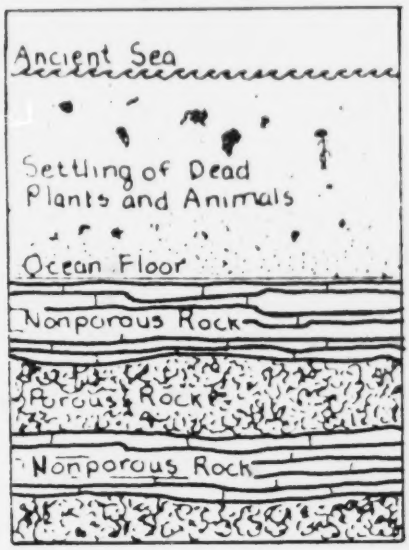
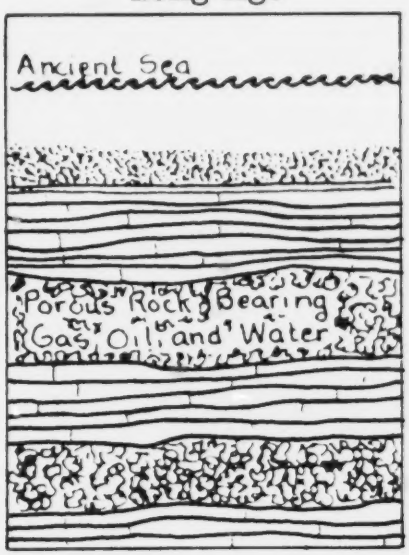
"NATURAL GAS FORMATION"

Name _____ Date _____

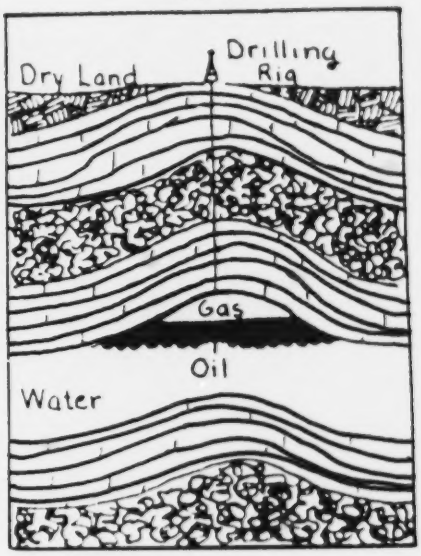
Long, Long Ago



Long Ago



Now



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Activity No. 4

Science
Art, Social Studies

uses | grade | time

"Energy Trip Ticket Game"

2

5-30 min.

Concept
Every energy use decision affects standards of living and quality of life.

Objective
Given the opportunity, the student will be able to recognize that energy conservation affects our standard of living.

Materials
Magazines
Glue
Butcher paper
Energy Trip Tickets
(included with this lesson)

Implementation

1. Using magazine pictures, have students make collages depicting the use of energy in the following areas:
   A. Things we use at home.
   B. Things we use and do for fun.
   C. Things we use for transportation.
   D. Things we do for work (jobs).

   You may want students to work in small groups and then share collages with the class.
2. Class discussion: Compare the use of energy depicted by each collage. How are they alike? How are they different?
   A. Which items on our collages make our lives easier and more comfortable? How?
   B. Discuss the idea that it takes a lot of energy to have and do the things depicted on the collages.
3. To get the student to really understand that it takes a lot of energy for people to have and do things, play the "Energy Trip Ticket Game":
   A. Make a standardized energy ticket on ditto master, run off, cut, and give each student 15 tickets. The student's name should be on each of the tickets or else the student should have a deposit place marked with his/her name. Each time the student takes a trip it costs one energy ticket.
   B. Keep a record of how many tickets the students have left each day. Which students are wasting energy? Which students are conserving energy? How are they doing it? Discuss energy saving ideas for trips to the classroom, e.g., at recess I can get a drink, sharpen my pencil, and go to the restroom for one ticket. Otherwise it would cost me four ticket to make each trip at one time.

      This stresses the idea that in one trip we can accomplish several things.
   C. To introduce the game to the students, list several places the students go in school and charge one energy ticket for the cost of each trip. Examples:

      Pencil sharpener
      Drinking fountain
      Restroom
      Lunch
      Recess
      Music/P.E.
      Library
      Other
   D. On the third day, discuss the idea of running out of energy tickets. There are no energy tickets left for the rest of the week. What can we do to save? What will it cost? What effect will it have on our classroom standard of living?
   E. On the fifth day discuss the impacts the "energy shortage" had on the use of energy—the number of trips students made.
4. Using the collages, ask students wich activities would be affected the most if an energy shortage occurred. How would that influence our lives, use of energy?

Suggested Assessment
Have students draw a picture of themselves using energy. Have them explain their picture to the class.

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Activity No. 5

Science
Art

uses	grade	time
	2	45 min.

"Energy Talk"

Concept
Each form of energy can be used in many ways.

Objective
Given the opportunity to ask questions about energy uses, the student will be able to identify energy sources.

Materials
Samples of:
Coal, Water, Wind (balloon of air), Wood, Oil
Gasoline, Food

Implementation

1. This activity is played much like "20 Questions" game. The teacher will bring to class for display samples of gasoline, coal, water, oil, food, wind (a balloon of air), and wood. Discuss with the class how each of these energy sources is used by filling in the chart when students give a suggestion.
2. Select one student to come up to the front of the class and choose an energy source without anyone else knowing its identity. The student tells the teacher which energy source he/she selected.
3. Have classmates ask questions that can be answered by yes or no about the energy source. The questions can reflect how the source is used and what it is like. (Example: Is it used in cars? Is it black? Is it burned in a stove?, etc.)
4. After at least 10 questions have been asked by the group, a student may choose to pick up a source of energy and ask "Is it _____ (name of source)?" If the student is not correct, the questioning may continue or another student may attempt to identify the energy source. Once a student has attempted to identify an energy source and is not correct, he/she has to wait until the next round is played. If the student is correct he/she becomes the leader of the next round.

Suggested Assessment
Have students draw a picture of a person using the energy sources.

EXAMPLE:

Sun	Gasoline	Coal	Water	Oil	Food
homes	cars	stoves	waterwheels	cars	people
buildings	lawnmowers	factories	wheels	furnaces	animals
plants	trucks	electricity	dams	electricity	
heat	buses		electricity		
light					
electricity					

Wind	Wood	Geothermal	Natural Gas
sailboats	stoves	heat buildings	electricity
boats	factories	electricity	heat
windmills			
electricity			

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Activity No. 6

Science
Art

"Growing a Plant"

conversions grade 2 time 3-30 min.

Concept
There are human made and natural energy conversion systems.

Objective
Given the opportunity, the student will observe a natural conversion system.

Materials
Soil
Plant containers
Seeds
Collage material
Film:
"Food From the Sun," 10 minutes, color EBEC 1965, primary level

Implementation
1. Have your students obtain two small containers in which to grow plants.
   A. Prepare a soil mixture.
   B. Plant seed of choice.
2. Explain to students that plant growth is the result of conversion of the sun's energy. Plants will not grow or produce food (for the plant or for other people or other animals) without the sun's energy.
3. After they have germinated, place one plant in the dark. Place the rest in the sunlight.
   A. Observe the plants in both situations once a week for several weeks. Discuss the differences between the two.
   B. Questions to discuss:
      —What do you observe about the plant in the dark?
      —What do you observe about the plants in the light?
      —Which plants look the healthiest, dark, light? Why?
      —What does the sun's energy or light do for the plants?
      —How did the plant use the sun's energy?
      —Will the plant bend toward the sunlight when turned in various positions?
      —Does this show the plant is affected by the sun?
4. Make a "Sun-Energy Food Collage." Students in small groups cut and paste pictures on butcher paper using a sun symbol as a focal point. Use examples that include fruits, other food parts, and entire plants. Explain that plants use the sun's energy for growth and making food.

Suggested Career Awareness Activity
1. Invite a gardener to come to speak to the class about his/her job.
2. List names of jobs in which people work with plants (e.g, farmer).

Suggested Assessment
Given the opportunity, the students will take proper care of the plant, discuss results of plant growth, and participate in the making of a collage.

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Activity No. 7

Science
Art, Mathematics

"Heat From the Sun"

conversions grade 2 time 45 min.

Concept
The efficiency of energy conversion systems differ.

Objective
Given the opportunity to make an observation through investigation, pupils will discover that solar energy can be converted to heat energy for home use.

Materials
2 pieces of ½" copper or aluminum tubing approximately 12-14" long
1 large shiny funnel or cardboard cone lined with aluminum foil
2 thermometers
Ring stands

Implementation
1. Place a stopper in one end of each piece of tubing and fill the tubes with water. Use an equal amount and temperature of water in each tube.
2. Place one tube into the funnel and secure it in place.
3. Insert a thermometer into each tube far enough so the bulb is in the water and the top visible above the tube.
4. Place both tubes in direct sunlight, mounted in a ring stand, with the sunlight shining down into the funnel and reflecting on the tube.
5. Ask the students to observe the rate and amount of temperature change of the water in each tube. Make a line graph, on the chalkboard, noting temperature and time. Make observations every minute for 30 minutes. What caused the differences in the two systems? Why? Was the sun's energy converted to heat? How do we know? How could the sun's energy be used in our homes or schools?

Suggested Career Awareness Activity
Field trip: Visit a solar home and see how solar panels work. Talk about passive solar heating that comes through windows or have contractor visit your classroom.

Suggested Assessment
Have students make a picture showing the sun being used as an energy source for homes and schools.

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Activity No. 8

Science
Art

"Recycling"

impacts | grade | time

2 | 4-45 min.

Concept
Energy conservation efforts interact with economic conditions.

Objective
The student will be able to describe conflicts that can be resolved by technological, recycling and/or reusing processes.

Materials
"Poppy Pop Bottle" story
Paper
Crayons

Implementation

1. Discuss with students the word "litter." Discuss the problem of litter in the hall, or classroom. Ask students:
   A. How does the litter in the hall make you feel?
   B. What would it be like if no one cleaned it up and more was added each day?
   C. What rules would you make to keep the area clean?
   D. How is our problem of litter like the problem in our community?
   E. What rules would you make to keep the community clean?
   F. What do you think the word *litter* means?
   G. Let's make a list of the kinds of litter we have in our community.
2. Take your students on a short walk around the school yard and surrounding area. Make a collection of different kinds of litter they see. Bring to the classroom and make a display and decide what to do with your collection. Explore alternatives and select one by voting.

   Stress the idea that recycling waste helps to reduce litter and conserve energy. Also that some people and factories reuse such things as newspaper, bottles, and cans to help reduce litter and waste and conserve energy.
3. Discuss with the class the rules people should follow concerning litter. Why are these rules important? Make up rules the class will follow about classroom litter and recycling that litter. Try to state the rules in positive terms rather than negative. Decide what the consequences will be if the rules are not followed. Point out individual responsibility and team effort. Elect a class enforcement officer. Court cases may arise. Have a court session if necessary. Invite a policeman to come to class. Ask about litter and recycling laws. What is the importance of these laws? How are they enforced? What do people need to know about them? How can the class help?
4. Have the class read and color the "Poppy Pop Bottle" story. Discuss these questions with your students:
   A. What is recycling?
   B. Why do you think people recycle pop bottles?
   C. What might happen to all the pop bottles if they were not recycled?
   D. What reasons do you think there are for putting pop in glass bottles rather than material like milk cartons?
   E. Do you think there should be laws telling people and factories to recycle pop bottles? Why? Or why not?
   F. Are there other ways to recycle pop bottles?
5. You may wish to show and discuss one of the following films:
   Garbage Dumps, Ealing 1970
   Urban Ecology, Ealing 1970
   Little Monster, Kiggins 1970
   Garbage, King, S.P. 1960
6. Have students bring used bottles, milk cartons and cans to school. Make a list of ways you could recycle the items. Have students recycle the items by making something useful from them.

Suggested Career Awareness Activity
Invite the city sanitary engineer to discuss how garbage is collected and disposed of.

Suggested Assessment
Have students make a series of pictures illustrating how an item is recycled.

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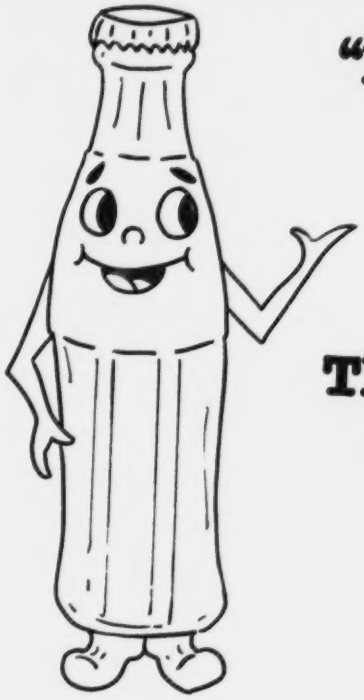
Activity No. 8



"RECYCLING"

THE STORY OF POPPY POP BOTTLE

1

WORDS TO KNOW:

CARTON	MONEY
FACTORY	RECYCLING
FLAVORS	REFUND

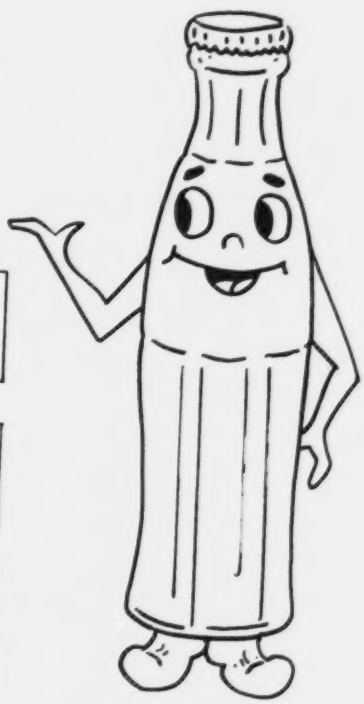
2

CAN YOU COLOR THE BLOCKS?

GRAPE

ORANGE

LIME



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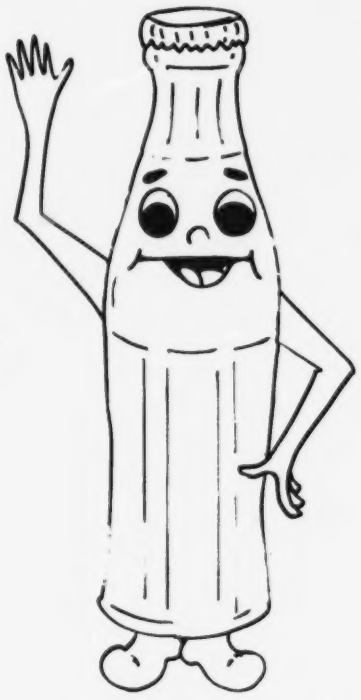
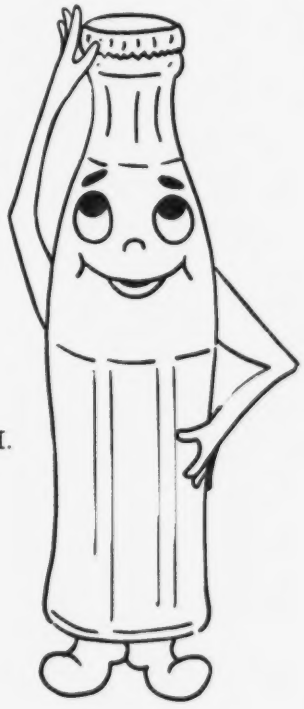


HI! I AM POPPY POP BOTTLE.

I AM HAPPY.

LET US TALK ABOUT ME.



I AM MADE OF GLASS.

MY POP IS GOOD TO DRINK.

YUM! YUM!

I HAVE A CAP TO KEEP MY POP FRESH.

4

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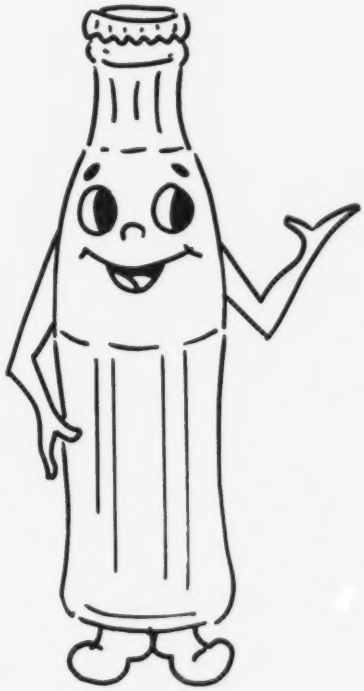
I COME IN ALL KINDS OF FLAVORS,
SUCH AS ORANGE, GRAPE AND LIME.

BOYS AND GIRLS LIKE MY POP.

THEY DRINK IT FAST.
I AM USED OVER AND
OVER AGAIN.

CAN YOU COLOR US?

5



YES, I AM HAPPY.

I AM USED OVER, AND OVER
AND OVER AGAIN.

I CAN CARRY POP DRINK
MANY, MANY TIMES.

LET ME TELL YOU
HOW I DO THIS.

6

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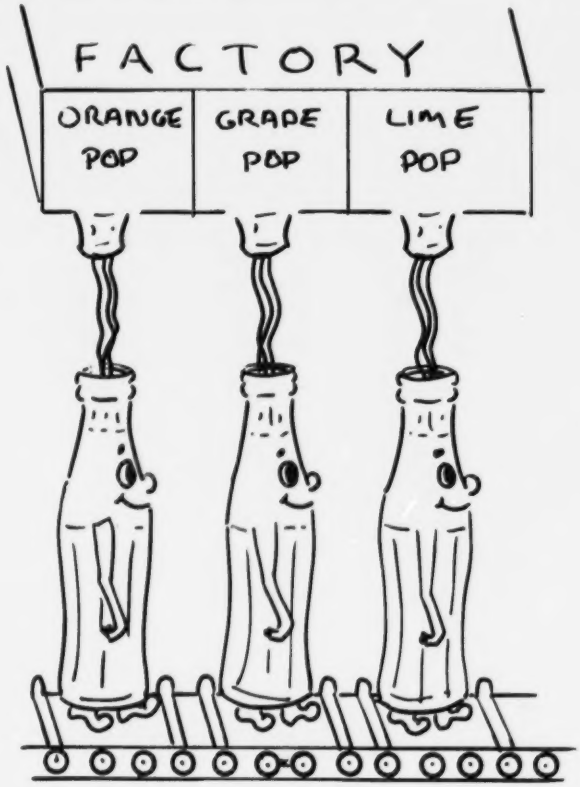

7

AT THE FACTORY, PEOPLE
MAKE ALL FLAVORS OF POP.

THEY PUT ONE
FLAVOR IN ME.

WHEN I AM FULL
THEY PUT A CAP ON ME.

CAN YOU COLOR US?

8

THEY PUT ME IN A
CARTON SO THAT I
CAN BE SENT TO
THE STORE.

THEY SEND ME
ON A TRUCK.

CAN YOU COLOR US?

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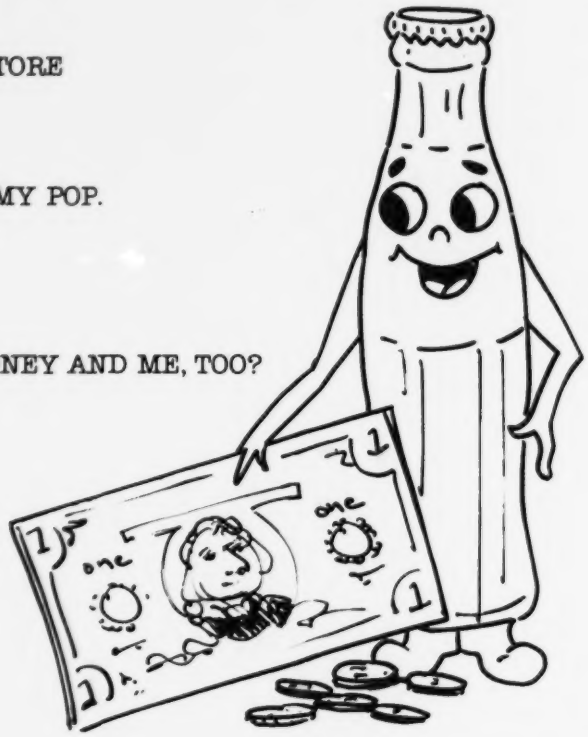
9

PEOPLE COME TO THE STORE
TO BUY ME.

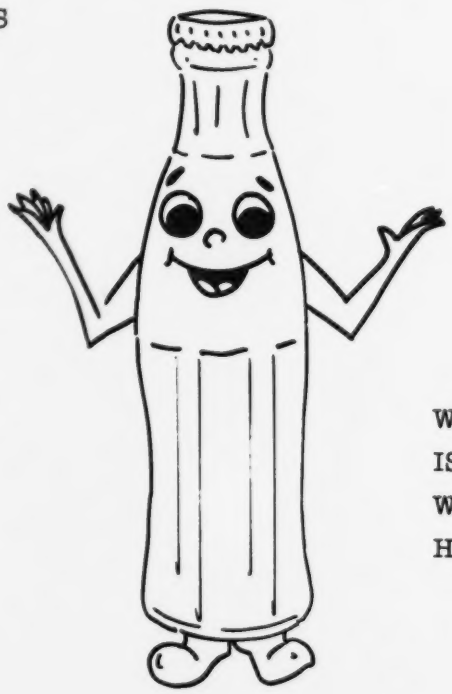
THEY PAY MONEY FOR MY POP.
THEY PAY MONEY FOR
ME, THE BOTTLE, TOO.

CAN YOU COLOR THE MONEY AND ME, TOO?



10

BOYS AND GIRLS
DRINK MY
POP FAST.



WHEN MY POP
IS ALL GONE,
WHAT WILL
HAPPEN TO ME?

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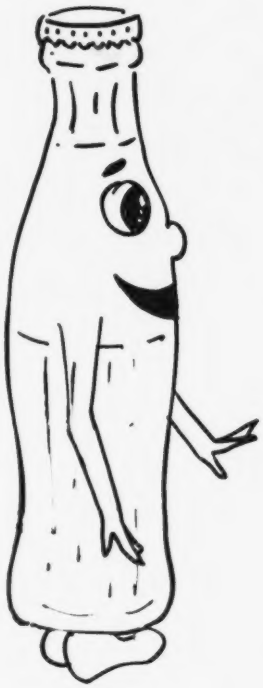


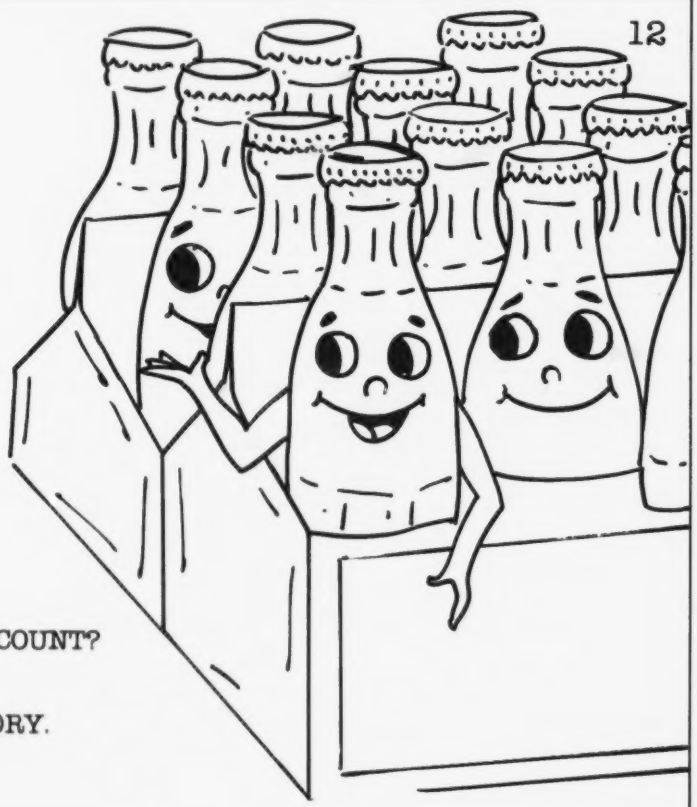
ALL MY POP IS GONE.

BOYS AND GIRLS TAKE
ME BACK TO THE STORE.

THEY WILL GET MONEY
BACK FOR ME.

THIS IS CALLED A
POP BOTTLE REFUND.

12



I AM KEPT IN THE
STORE. A TRUCK
WILL COME TO
PICK ME UP.

I WILL GO BACK
TO THE POP FACTORY.

HOW MANY BOTTLES CAN YOU COUNT?

WE WILL ALL GO TO THE FACTORY.

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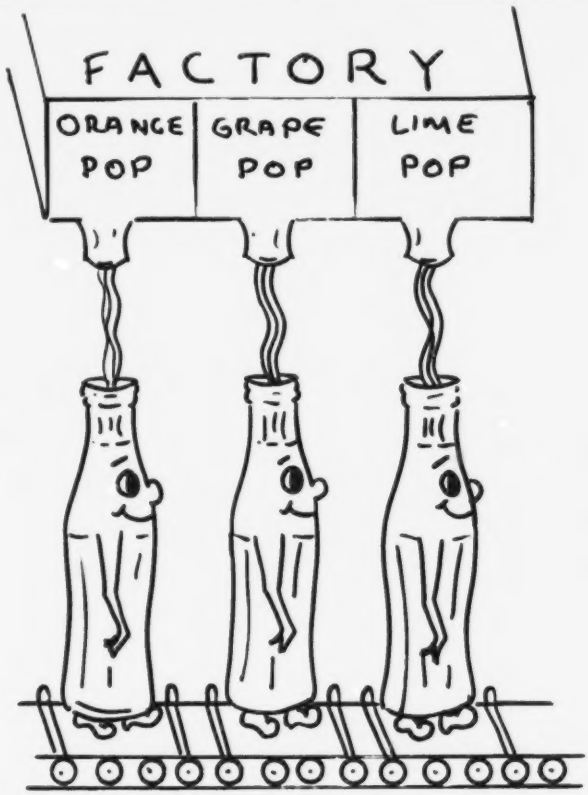


AT THE FACTORY THEY
WILL WASH ME.

THEY WILL PUT MORE
POP IN ME.

THEN I WILL GO BACK
TO THE STORE TO
BE SOLD AGAIN.

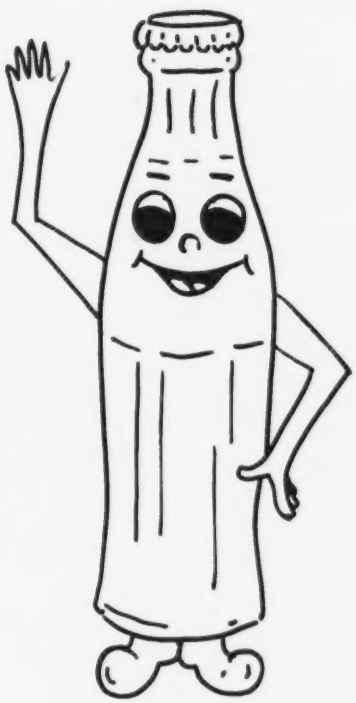
14

YES, I AM HAPPY
BECAUSE I AM USED
OVER AND OVER AGAIN.

I CARRY POP DRINK
MANY TIMES.

THIS IS CALLED "REUSING."

CAN YOU TELL MY STORY?



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Science

limits	grade	time
	2	5-30 min.

"How Long Will It Last?"

Concept
All energy resources have limits to their usefulness.

Objective
Given the opportunity, the student will observe the depletion or limits of several common energy sources.

Materials
Flashlight and batteries
Candle
Sugar cubes
Raisins

Implementation

1. Flashlight energy: Turn the flashlight on and leave it on until the energy is used up. Have the students estimate or predict how long they think the energy in the batteries will last. Relate this investigation to the idea that the electrical energy in the batteries will last only a certain amount of time. The energy is limited.
2. Candle energy: Using a small birthday candle, have the students estimate how long the candle will burn, giving off heat and light energy. Again, relate this investigation to the idea that energy stored in the candle will last only a certain amount of time. The energy is limited. The energy in the candle is chemical energy from oil.
3. Food energy: Distribute sugar cubes to the class, one per student. Tell them to conserve it as much as possible and see if they can make it last for a couple of days, as this is the only cube they will receive. At certain times during the day, have the students lick or nibble their cubes. Relate the activity to the fact that the food energy of the sugar is limited. It will last only so long.
4. Display a bowl of raisins in front of the room. Tell the students that they are going to experiment with raisins by eating them, and that they must see if they can make the raisins last for several days. Explain to the students that the supply is limited. When the raisins are gone they will not be replaced. Instruct the students by telling them that at anytime they want a raisin to feel free to eat one. When the raisins have been depleted discuss with the students what factors determine how long the supply lasts: size of class (population), use, alternative sources.
5. As a summary, discuss with the students the meaning of the word "limited," using the experiences the students have had with the activities. Relate "limited" to energy resources, such as coal, oil, and natural gas. Also discuss what a renewable resource is, e.g., wood, water, sun, wind. Why aren't they limited like nonrenewable resources?

Suggested Career Awareness Activity
Invite the school cook to visit the class to talk about his/her job in relation to planning the use of food so that everyone gets his/her share of the limited amount of food that is cooked each day.

Suggested Assessment
Have the students place an "L" next to the energy sources which are limited."

1. Coal
2. Oil
3. Sun
4. Wind
5. Wood
6. Water
7. Natural gas

Answers
1, 2 and 7

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Activity No. 10

Science

future	grade	time
?	2	60 min.

"Something That Lasts"

Concept
Different consumption practices may alter future demands on energy resources.

Objective
Given the opportunity, the student will identify that consumption of different energy sources alters future demands on energy sources.

Materials
Drawing or writing paper
Once There Was A Tree—
Phyllis S. Busch, World Publishing Company, 1968

Implementation
1. Read *Once There Was A Tree* to the students, which tells the life story of a tree. It emphasizes the many uses of the tree over a long period of time.
2. Discuss with the class the many ways in which the tree is useful. Discuss how the tree was used in the past and how it may be used in the future. Show the overhead depicting the use of the tree as an energy source. Ask: "How has different energy source use practices influenced the demand on wood as an energy source?" "Have any other energy sources been influenced by use practices?" "What use practices may alter future demands on energy sources?"

Suggested Assessment
Have students divide a sheet of drawing paper in half. On one half have them make a drawing of one use of wood. On the other half, have them make a drawing where the wood is replaced by some other item.

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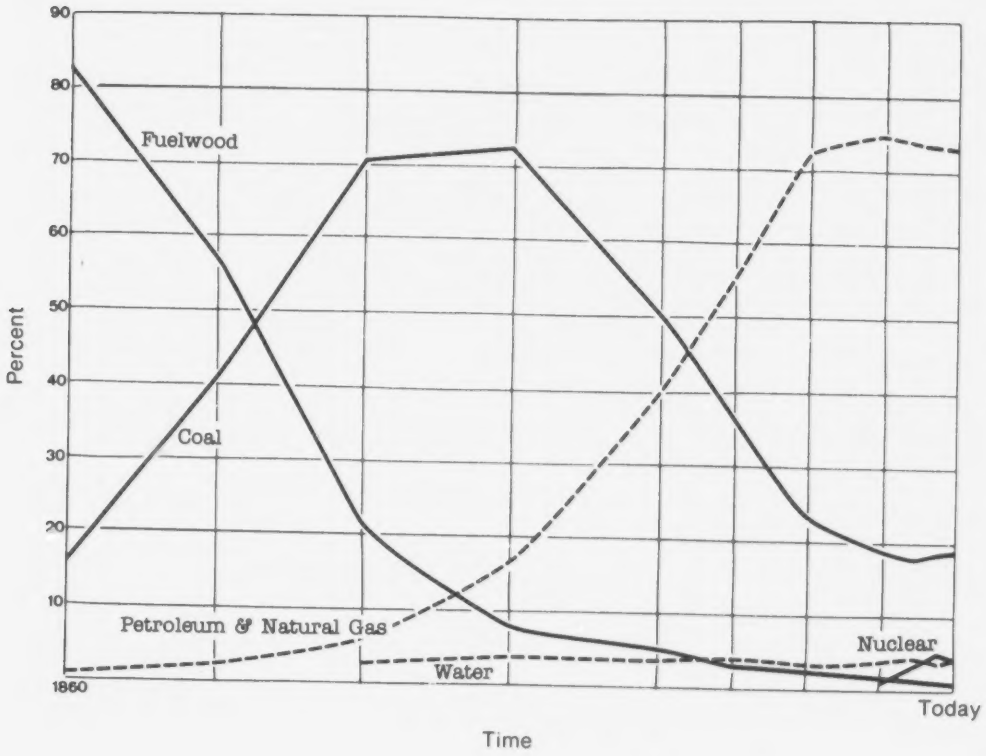
"CHANGING SOURCES OF ENERGY: PERCENT OF TOTAL CONSUMPTION"



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Activity No. 11

Science
Art, Mathematics

conservation | grade | time

"The Best Color"

2

60 min.

Concept
There are various methods to conserve energy.

Objective
Given the opportunity to experiment, the student will be able to explain that the color of paint can affect the absorption of heat energy.

Materials
Cans
Paint (white, black, red, green)
Hot water
Thermometers
Aluminum foil

Implementation

1. Divide the class into groups of four. Each group will paint four cans: one white, one black, one green, and one red.
2. Have each group fill their can with the same amount and temperature of water. The water should be hot. Put a thermometer in each can and cover top with foil. The cans should then be placed in the sun. Record the temperature every two minutes for twenty minutes. Make a data table on the chalkboard to record each group's data. Make a line graph on the chalkboard to illustrate the students' data (average).
3. Which color would be best for painting homes, schools and other buildings to keep them warm in winter? Which color of clothes would be warmer in the winter? Cooler in the summer? How would the color of objects conserve energy?

Suggested Assessment
Ask students the following questions:

1. On a warm summer day what color of clothes would you wear to stay cool?
2. What color house would be warmer in the winter, red, white, black, green?

Answers
1-white, 2-black

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Activity No. 12

Science
Art

"If Animals Insulate, Why Do We Wait?"

conservation

grade 2

time 2-45 min.

Concept
There are various methods to conserve energy.

Objective
Given the opportunity to study animal habitats and body coverings, the student will understand how insulation can reduce human energy consumption.

Materials
2 thermometers
Old bird's nest
Piece of sheep's wool (or wool hat or mitten)
Picture of polar bear
Box, pail or cup of soil
Pictures of pets, dogs, cats, horses, rabbits.

Implementation

1. Show the class the bird's nest, the picture of the polar bear, the piece of sheep's wool and pictures of domestic animals. Ask the students how the nest, the wool and the winter coats of animals are alike. (They all keep the animals warm.)
2. Discuss how these animals turn up their thermostats to keep warm.
3. Have the students perform experiments to answer question #2. (Go outside for quicker results.)
   A. Put one thermometer in the nest lining—the other on the ground. Compare.
   B. Put one thermometer in the sheep's wool—the other on the ground. Compare.
   C. Put one thermometer in the soil—and the other on top of the ground. Compare. Discuss animals that live in the ground for warmth.
4. Discuss ways that people imitate animal behavior.
   A. What do we do to our houses that is similar to a bird's nest lining? (Insulate, weatherstrip.)
   B. If our feet are cold, do we turn up the thermostat, or do we copy Mr. Polar Bear and wear "furry" slippers?
   C. If we are chilly while reading in the house, do we turn up the heat, or put on warm wool sweaters like Mr. Sheep?
5. Extending the idea: Art Project—Have the students draw or paint a picture showing children and their animal friends practicing "warm" energy saving habits. Pictures may be extended by gluing small bits of cotton to the painted or drawn pictures.

Suggested Assessment
Match the animal to a conservation practice to keep warm and save energy.

1. Rabbit grows more fur
2. Chipmunk puts grass in his home
3. Ground squirrel sits in sun

A. Add insulation to walls and ceiling of house
B. Put on a sweater
C. Open shades or curtains to let sun shine into house

Answers
1-B, 2-A, 3-C

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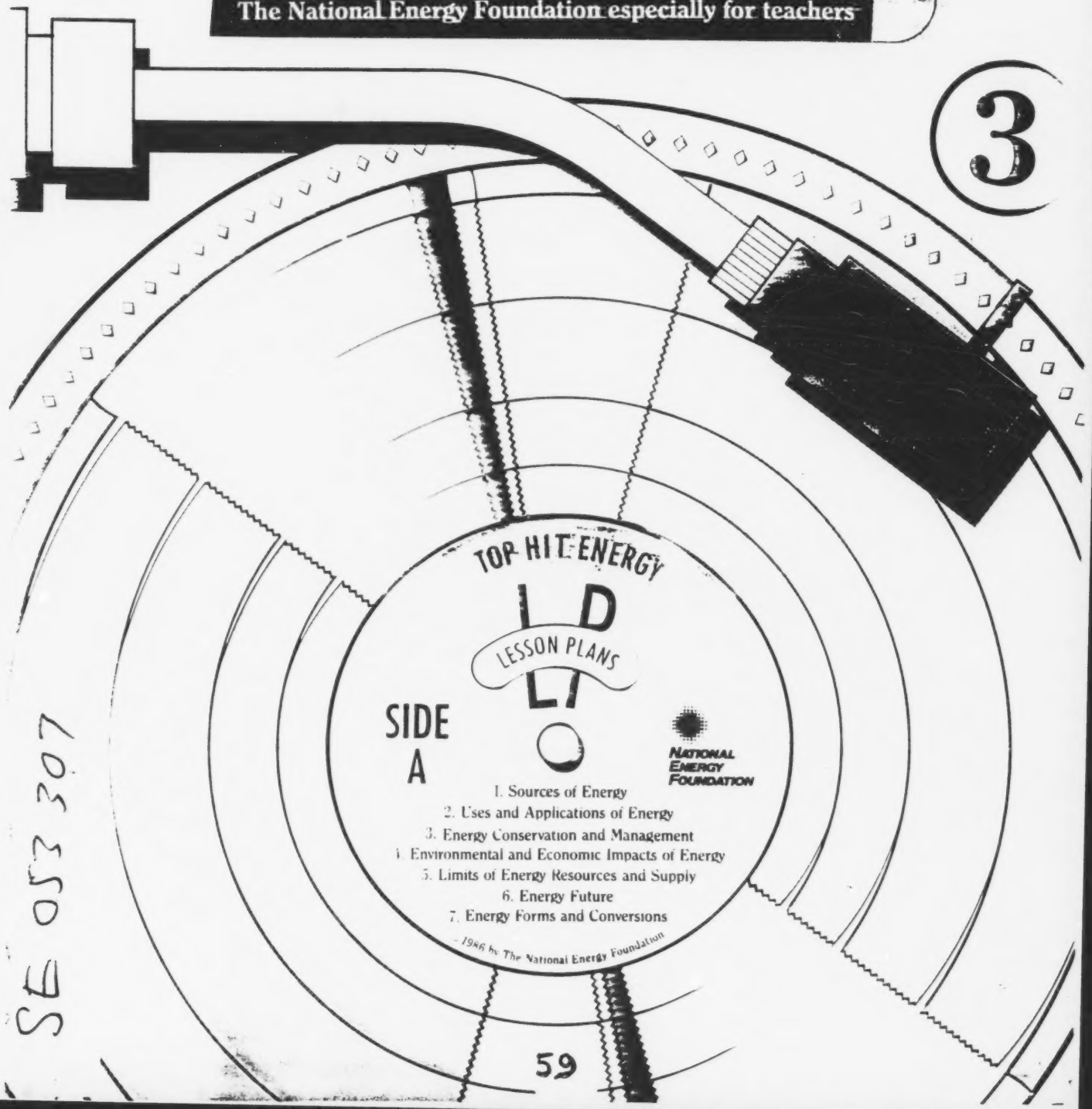
ENERGY

Multidisciplinary activities for the classroom developed by The National Energy Foundation especially for teachers

3



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NATIONAL ENERGY FOUNDATION
Resources for Education

About the National Energy Foundation

The National Energy Foundation (NEF) is a unique nonprofit educational organization devoted to the development of instructional materials and teacher and student educational programs dealing with energy. NEF is supported by resources from business, government and education. NEF's primary concern is to present energy, science, technology and contemporary issues accurately and objectively.

To the Teacher

NEF instructional materials are teacher-developed, teacher-tested and multidisciplinary. The instructional materials are developed in accordance with NEF's **Conceptual Framework**. The seven goal areas of the **Conceptional Framework** are: Sources of Energy, Uses and Applications of Energy, Energy Forms and Conversions, Environmental and Economic Impacts of Energy, Limits of Energy Resources and Supply, Energy Future, and Energy Conservation and Management. Each goal area is then divided into concepts which are necessary to a fundamental understanding of energy. Listed under each concept are simply stated objectives.

About the Elementary Lesson Plans

The enclosed elementary lesson plans and activities have been selected as those most preferred by teachers and students. They have been designed for use within NEF implementation workshops. Included within each of the activities is a complete breakdown as to the time needed for implementation, materials required, implementation procedure, assessment questions, student handout masters (for duplication), identification of optional activities or career education suggestions and other information pertaining to the successful completion of the activity.

Warning: some of the activities are potentially hazardous due to the use of flammable substances and/or heat. Please exercise extreme caution. Check your local and state laws governing the use of flammable materials in the classroom. In addition, always be alert to possible electrical hazards. Each school year should begin with a review of the safe use of electricity, and each activity involving the use of electricity should be preceded by a reminder of safety procedures.

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3. "Electrical Appliances Save Time, But How About Energy?"	Uses	X	X		X		Careers Science/ Technology	6
4. "The Pencil Tree"	Uses	X		X	X		Careers	7
5. "Energy Web Game"	Uses	X		X				9
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7. "A Bright Idea"	Conversions	X					Careers	11
8. "Pass the Sack"	Limits	X		X			Careers	12
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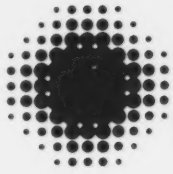

NATIONAL ENERGY FOUNDATION

Resources for Education

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Activity No. 1

Science
Art, Social Studies

"Using My Senses"

sources grade **3** time **7-45 min.**

Concept
Energy sources can be classified in many different ways.

Objective
Given the opportunity, the student will become familiar with the sources of energy and where they are found.

Materials
The teacher should use a wide variety of audiovisual materials. Suggested in these lessons are the following:

Films:
- "Coal: A Source of Energy," 15 minutes, color, McGraw-Hill, 1967.
- "Forest Gives Us Wood," 11 minutes, color, U.S. Forest Service, UWF, 1965 (fuel forest reserves).
- "The Big Dinner Table," 11 minutes, color, NEW, 1968.
- "Food Energy and You," 10 minutes, color, NEW, 1968.
- "Little Bluebird's Valley," 11 minutes, color, COR, 1971.
- "We Use Power," 10 minutes, color, Churchill, 1956.
- "Energy and Power: A First Look," 10 minutes, color, Altschul Journal, 1962.
- "Powerline: Transportation of Energy," 11 minutes, color, Barr, 1971.
- "Wind: A First Film," 9 minutes, color, BFA, 1966.

Filmstrip:
- "The Earth's Resources: Fuel Resources," McGraw-Hill, 1970.

Butcher paper
Felt tip markers
Samples of coal, oil, gasoline, kerosene, water, wood and food.

Implementation

1. Sensory observations of basic energy sources. The teacher needs to collect samples or pictures of the following:

   Coal
   Oil
   Kerosene
   Running Water (faucet)
   Food
   Wind (fan, outside wind)
   Sunlight (hard to collect)
   Natural gas (propane)

   *Oil, gasoline and kerosene are dangerous substances to use in the classroom. Exercise caution and be advised of local and state laws governing the use of these substances in the classroom.

   A. Have students examine and observe the various samples, comparing them for similarities and differences. Record student observations on a chalkboard.

   B. Show films. "Energy and Power: A First Look" and "We Use Power."

2. Show film, "Coal: A Source of Energy," and filmstrip, "The Earth's Resources: Fuel Resources."

   A. Discuss these and point out that both of these are fossil fuels mined from within the earth.

   B. Have students make pictures showing the extraction of fossil fuels.

3. Show film "The Forest Gives Us Wood."

   A. Discuss film. Discuss harvesting wood as a source of energy.

   B. Have students make pictures depicting the lumbering industry and others showing how wood has been used as a fuel source.

4. Water sources (rivers, streams, dams used with running water).

   A. Show film, "Little Bluebird's Valley."

   B. Next show the film, "Powerline: Transportation of Energy."

   C. Have students draw pictures of water as an energy source. Point out that water power is often used to create electrical energy, after falling many feet and turning turbines to generate electricity.

5. Wind sources. Show film, "Wind: A First Film."

   A. Discuss, after film, man's past and present use of wind as an energy source.

   B. Have students draw pictures showing uses of wind energy.

6. Food: An energy source.

   A. Show the films, "The Big Dinner Table," and "Food Energy and You." Discuss the sun as an energy source for plants, and plants as an energy source for man.

   B. Ask how many students would be willing to miss several meals. Why? Point out to students our need for the energy from food to keep ourselves active and healthy.

   C. Have students draw pictures showing food as an energy source.

7. Discuss the sun as a source of energy. Discuss our dependence on the sun for our existence.

Suggested Career Awareness Activity
Whenever possible in this unit, point out the energy-related jobs people do.

Activity 1 continued

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Suggested Assessment
Have students match the energy source to the characteristics.

1. Used to make electricity.
   Formed from dead plants.
   Not a liquid.
   Black in color.
2. Provides heat and light.
   Not a solid.
   Renewable.
3. Naturally has no smell.
   Not a solid.
   Burned to make heat.
4. Not a gas.
   Formed from marine plants and animals.
   Often black, but sometimes brown.
   Used to make gasoline.

A. Natural gas
B. Oil
C. Coal
D. Sun

Answers
1-C, 2-D, 3-A, 4-B

SAMPLE CHART

List student responses on chart for discussion.

Observation	coal	oil	gasoline	kerosene	water	wood	food	wind	sunlight
Seeing Color	black	brownish	yellowish		colorless		several		
Feeling Texture	rough	slick sticky etc.					several		hot warm
Weight Relative to Size									no weight
Solid Liquid Gas		liquid					solid liquid		
Smell							sweet bitter		
Shape			no shape				several		no shape
Use									
Formation									

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Activity No. 2

Art
Science

"Drawing Relay"

sources	grade	time
	3	45 min.

Concept
Energy sources can be classified in many different ways.

Objective
Given the opportunity to participate in a drawing relay, the student will be able to identify energy sources.

Materials
Construction paper
Pencils

Implementation

1. Arrange the students in groups of five. Have them sit on the floor or at tables in a circle at various locations in the room.
2. Place one pencil and some paper in the center of each circle.
3. Number the students in each circle from 1 to 5. Seat yourself as far away from the circles of students as you can.
4. When the signal is given, the first student from each circle comes to you. He/she is to come without pencil or paper. Tell each one the name of the first item on the list. (See list provided.)

   A sample list of items or objects follows:

Sun	Coal
Steam	Hydro
Wood	Natural Gas
Food	Nuclear
Wind	Geothermal

5. Each student returns to his/her respective circle, takes the pencil in the center and draws (without talking) the item until someone in the circle identifies it, using a soft voice. Remind students that if they yell out what is being drawn, others will hear.
6. The second person in the circle comes to you and tells you what the group has determined the drawing is.
7. If they are correct, give that student a new object to draw. If incorrect they return and try again.
8. After completing the "Drawing Relay," discuss each of the energy sources with the students, e.g., their characteristics, how each is used to provide us with energy, whether they are renewable/nonrenewable, how are they formed, etc.

Suggested Career Awareness Activity
Have the students draw a picture of a person working with one of the energy sources used in the activity.

Suggested Asssessment
Have students select an energy source and draw a picture illustrating all they have learned about that energy source.

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Activity No. 3

Science
Art, Mathematics

"Electrical Appliances Save Time, But How About Energy?"

uses	grade	time
	3	60 min.

Concept
Every energy use decision affects standards of living and quality of life.

Objective
Given the opportunity, the students will be able to recognize how people use energy in the home to do work that once was done by hand.

Materials
Electric drill, hand drill
Electric mixer, egg beater, bowls, flour, water
Electric can opener, hand can opener.
Collage material (magazines, scissors, glue)
Film: "Spin! Toot! Scoot!"
Martin Moyer Productions
900 Federal Avenue
Seattle, WA 98102

Implementation
1. To get the students thinking about the amount of human energy spent and the amount of time it takes to do things, ask them if they would rather walk, ride a bike or ride in a car 5 miles to a friend's birthday party.
   A. Ask them why they chose what they did.
   B. Which would take the longest amount of time? The least?
   C. Which would take the most effort? The least?
   D. Which would be the best exercise? Why?
2. After the above discussion, the teacher demonstrates an electric knife, electric can opener, electric mixer, and electric drill to illustrate how people use energy to save time and effort. Have students keep track of time as you:
   A. Cut a bar of soap with the electric knife and a hand knife.
   B. Drill a hole in a block of wood with an electric drill and a hand drill.
   C. Mix flour and water with an electric mixer and a hand mixer.
   D. Open the bottom of empty cans with an electric can opener and a hand can opener.
3. Construct a bar graph to visually illustrate/compare the times in step 2. Discuss with students that we often use energy to make work easier and to save time.
4. Discuss the advantages and disadvantages of using so many convenient devices. Be sure to relate to the standard and quality of life.
5. Make a collage depicting the home devices people use to reduce their work. Have students cut pictures from old magazines.
6. Show film: "Spin! Toot! Scoot!" Relate to ways we use energy.

Suggested Career Awareness Activity
Invite a homemaker (mother or father) to talk to the students about his/her job and how the use of convenient home devices affects his/her job.

Suggested Assessment
Have the student list at least 4 home devices that are used to make work easier or to save time.

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Activity No. 4

Science
Social Studies, Art

"The Pencil Tree"

uses	grade	time
	3	2-45 min.

Concept
Each form of energy can be used in many ways.

Objective
Given the opportunity, the student will draw an energy cycle depicting the making of a pencil.

Materials
A Pencil Tree made of a large branch "planted" in a container of plaster of paris with a pencil for each child hanging from it.

Used grocery sacks, old newspapers, colorful junk mail, old magazines, bowl, wood block, window screen about 5 x 7 inches, recycled plastic bag, corn starch or wallpaper paste, water, spoon, eggbeater, and patience.

Implementation

1. Present pencil tree to class as suggested under materials section. Begin discussion: "Where do pencils come from? How are they made? What materials are used? Where does the wood come from? How long does it take for a tree to grow big enough so that the wood can be used? (Pictures of trees of various sizes and ages will help illustrate this point.) Does it take energy to grow a tree? A tree is a plant and gets its energy from the sun."
2. Other points to be made: "Once a pencil is used, is it gone? There is no recycling a pencil. Proper use of a pencil sharpener will prolong the life of a pencil. A pencil is a tool and should be used properly."
3. Pass out drawing paper. Direct the students in drawing a large circle, and picture or list the steps necessary in making a pencil. Refer to the sample attached and share with the students.
4. Show the students a picture of a mature Douglas fir tree. Tell them that in a typical year, Americans use and *discard* paper equivalent to one Douglas fir per person every six months, or one pound per person per day. This is a tremendous waste of a resource, given that paper is one of the most recyclable materials. It can be pulped in water and made into roofing felt, insulation, fiber pipe, wallboard, cardboard, egg cartons, furniture, packaging, building materials, and last but not least, it can be recycled into many, many kinds of paper. Try the following paper-making activity with your class.

   Directions:

   1. Fill a bowl half full of water.
   2. Tear the paper into pieces.
   3. Soak the paper for an hour.
   4. Beat with an eggbeater.
   5. Dissolve two heaping tablespoons of corn starch or wallpaper paste into a pint of water; pour it into the bowl and stir.
   6. Hold the piece of window screen flat and lower it into the pulp. Repeat until you have a layer of pulp about 1/10th of an inch thick.
   7. Set the screen on a newspaper and place the plastic bag over it. Press down with a wood block—first gently, then with more pressure.
   8. Allow the fibers to dry for about 24 hours. Peel the fiber, then the paper, from the screen.

Suggested Career Awareness Activity

1. To illustrate how slowly a tree grows, invite a forester to talk to the class. At the beginning of the school year, have him/her help each child plant a tree seed.
2. Take a field trip to a local nursery. Have the nursery helper point out the ages of the various trees, how carefully the trees must be handled, and the cost involved.
3. Invite a representative from a recycling center to talk to the class.

Suggested Assessment
Have students diagram the energy pencil cycle.

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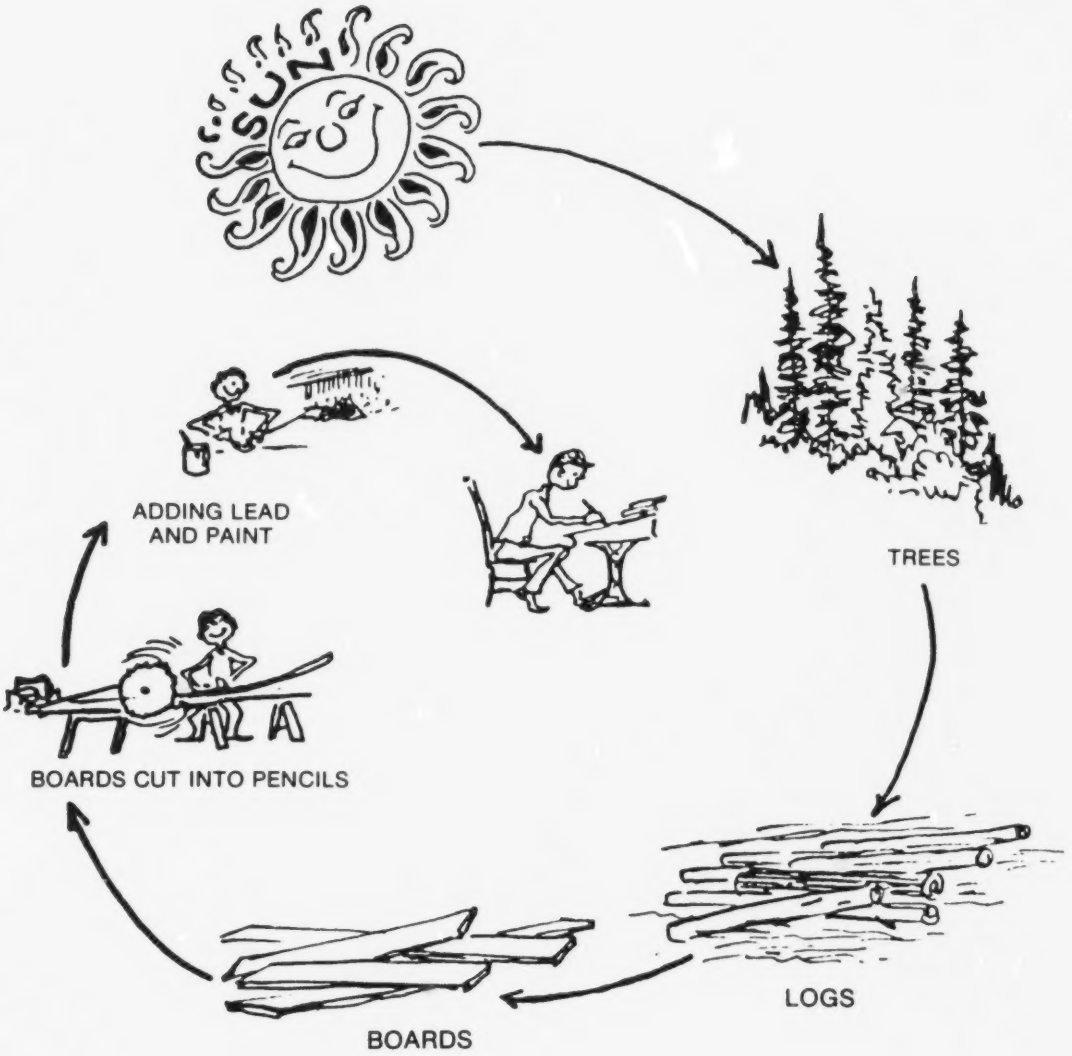
"THE PENCIL TREE"



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Activity No. 5

Science
Social Studies

uses | grade | time

"Energy Web Game"

3

45 min.

Concept
Each form of energy can be used in many ways.

Objective
Given the opportunity to play the "Energy Web Game," students will be able to recognize uses of energy.

Materials
Ball of blue yarn, length; 15 feet
Ball of black yarn, length; 10 feet
Ball of red yarn, length; 25 feet

Length depends on number of students.

Implementation

1. On the chalkboard, list the following energy sources: coal, oil, natural gas, nuclear and solar. Also list electricity, but inform students electricity is a form of energy generated from the energy sources.
2. Ask students to describe ways each source can be used, including electricity. List students' suggestions under the energy source.
3. Now erase the chalkboard and inform students you are going to play the "Energy Web Game" to see how well they listened.
4. Have students join you sitting on the floor in a circle. Show the students the three balls of yarn. Inform them that the red yarn represents electricity; blue, natural gas; and black, oil. Inform students we can play the game until we use up all of our energy.

   Inform students of the rules:

   A. The student with the ball of yarn selects any other student, and the selected student must give a correct use for that energy source. The selected student has the option to pass, in which case another student would be selected.

   B. If the student gives a correct use, the ball of yarn is rolled to that student, while holding onto the end of the yarn. Have them select another student and so on until you run out of yarn, making a web.

   C. Repeat with each ball of yarn.

   D. Only one person speaks at a time and everyone honors the speaker with full attention and eye contact.
5. Discuss the following at the end of the game:

   A. How many students did the yarn go to?

   B. Did different balls of yarn go to a different number of students?

   C. Did any balls of yarn go to the same student?

   D. What impact would more students have on the distribution and use of the yarn?

   E. Relate the game to the following through discussion.

      1. Each form of energy can be used in many ways.
      2. There are limits to the usefulness of energy sources.
      3. How population increases the impact on the use of energy.
6. Repeat the game, but this time have the students make a bigger circle.

   Discuss:

   A. How did this increased distance to pass the ball of yarn to students impact the number of students able to receive the ball of yarn?

   B. How might increased distance (transportation) impact energy available for use?

Suggested Assessment
List 3 uses for the following: oil, natural gas, and electricity.

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Activity No. 6

Science
Mathematics, Language Arts

"Food—Energy and You"

conversions | grade | time

3 | 7-30 min.

Concept
There are human made and natural energy conversion systems.

Objective
Given the opportunity, the student will keep track of the number of calories consumed in his/her school lunches and become aware that food is converted to energy in his/her body.

Materials
Calorie counter chart
Film: "The Big Dinner Table," 1968 (Nutrition Ed.)

Implementation
1. Using a calorie counter, keep track of calories consumed in school lunches, recording them on a chart.
2. Discuss with students how energy from food is used by the body.
   A. Some is used to keep the body warm.
   B. Some energy from food is used for growth.
   C. Some energy is used to perform work e.g., play, study, etc.
3. Discuss with students where the food got its energy and how plants convert the energy into food. Also discuss all the energy used to bring food to the students: farming, processing, packaging, transporting, storage, cooking.
4. Show film: "The Big Dinner Table."
5. Have students write a story about "Food—Energy and You."

Optional Activity
You may want to keep a height and weight (growth) chart on each student. Relate to food energy converted by our bodies.

Suggested Career Awareness Activity
Have the students interview the school cook about his/her job in preparing food; specifically ask him/her about nutrition habits.

Suggested Assessment
1. Where does the food get its energy?
2. How is energy used to bring food to people?
3. How does the body use energy?
4. What are some human and natural energy conversions necessary to get food to you?

Calorie-Protein Chart

VEGETABLES, SOUPS, & GRAIN PRODUCTS	Cal.
Avocado, ½ medium	263
Broccoli Stems, ¾ cup	35
Brussel Sprouts, ¾ cup	55
Corn (Canned) ½ cup	120
Kidney Beans (Cooked) ½ cup	88
Lima Beans (Cooked)	116
Navy Beans (Cooked) ½ cup	129
Peas (Fresh) ½ cup	129
Potatos (Baked) 1 medium	92
Potatoes (Sweet) 1 medium	130
Rice, Brown (Cooked) ½ cup	117
String Beans, ½ cup	48
Cream of Tomato Soup, ½ cup	143
Spaghetti, ½ cup	127
Macaroni (White, Cooked) ½ cup	130
Corn Flakes, ¾ cup	100
Oatmeal (Cooked) ½ cup	80
Shredded Wheat, 1 biscuit	108
Rye Bread, 1 slice	76
Whole Wheat Bread (100%) 1 slice	75
Graham Crackers, 2	84

MEATS	
Bacon (Crisp) 1 ½ slices	53
Beef (Lean) 1 slice	190
Bologna, 10 small slices	109
Chicken, 4 oz	125
Corned Beef, 4 oz	196
Frankfurters, 2 links	224
Ham, 4 oz	248
Lamb Chops, 2	350
Liver (Beef) 4 oz., 1 slice	140
Pork Chops, 2	340
Pork Sausage, 6 links	402
Steak (Beef) 1 slice	156
Turkey, 4 oz	153
FISH	
Fish, Avg. Serving	140
Tuna, Canned, ¼ cup	64
MILKS & CHEESES	
American Cheese, 2x1x1 in. pc	160
Cheddar Cheese, 2 tblsp	100
Cottage Cheese, ½ cup	100
Swiss Cheese, 1 slice	135
Fresh Whole Milk, 1 qt	660
Fresh Skimmed Milk, 1 qt	370
Condensed Milk, ½ cup	326
Whole Egg, 1	75
Egg Yolk, 1	58

DRESSINGS & SPREADS	
Butter, 1 square	77
Corn Oil, 1 tblsp	100
Olive Oil, 1 tblsp	135
Honey, 1 tblsp	101
Margarine, 1 oz	261
Mayonnaise, 1 tblsp	100
Peanut Butter, 2 tblsps	203
PASTRIES & DESSERTS	
Custard, ½ cup	126
Chocolate Pudding, ½ cup	272
Tapioca Pudding, ½ cup	118
Doughnuts, 2	481
Cookies, Molasses, 1 lg	100
Ice Cream, ½ cup	208
Chocolate Malted Milk, 13 oz	514
Chocolate Milk Shake, 13 oz	472
Chocolate Candy, with nuts, 1 bar	219
Milk Chocolate Candy, 1 bar	282
FRUITS & NUTS	
Almonds, 10 med	65
Apple, 1 small	64
Applesauce, ½ cup	42
Apricots (Fresh) 6 halves	70
Banana, 1 med	85
Cashews, 20 nuts	202
Cranberry Sauce, ½ cup	300
Orange Juice (Fresh) ½ cup	110
Peanuts, 18 nuts	110
Pecans, 10 large	229
Walnuts (English) ¼ cup	197
Prunes (Dried) 6 med	173
Raisins (Seeded) ½ cup	105

NOTE: This is a general diet, intended for a person in good health. Your physician is the best counsel for individual diet needs.

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Activity No. 7

Science

conversions | grade | time

"A Bright Idea"

3

60 min.

Concept
Energy occurs in many forms.

Objective
Given the opportunity, the student will observe potential energy converted to energy in the forms of heat and light.

Materials
Several dry cell batteries and holders
Wire, screwdrivers, small light bulbs and sockets
Film: "Energy: Ability to do Work," Cahill 1968

Implementation

1. Explain to students that the battery contains stored energy, or energy that has not yet been used. This is called potential energy. Show the students how to tap the energy from the battery by hooking up the wires to the battery and light bulb. (Discuss each step you perform, as the students will be asked to do the same in small groups.)

   Explain to students that when the light is on, energy (electricity) is being used to do work—make light and heat. While the light bulb is on, discuss:

   A. How do you know the energy from the battery is working?

   B. What is the bulb giving off?

   C. That the battery converts chemicals (chemical energy) to electricity (electrical energy) and that the light bulb converts electricity to light and heat energy.

2. If enough materials are available, have the students form groups of four or five. Give them the materials needed to perform the experiment, following the teacher's instructions.

   While the students are observing their experiment, have them note the light and heat energy given off.

3. Have students describe other types of potential and active energy. Active energy—energy in motion—is called kinetic energy. List student responses on chalkboard.

4. Show film: "Energy: Ability to do Work."

Suggested Career Awareness Activity
Have an electrician or electric utility person discuss their job.

Suggested Assessment
Fill in the blanks:

1. A battery converts chemical energy into _____ energy.
2. Electricity is a form of _____ energy.
3. The light bulb converts electrical energy into _____ and _____ energy.
4. A battery contains _____ energy.

Word choices:

Electrical, Active (kinetic), Light, Heat, Stored (potential)

Answers
1-Electrical; 2-Active (kinetic); 3-Light, Heat; 4-Stored (potential)

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Activity No. 8

Science
Social Science

limits | grade | time

"Pass The Sack"

3

45 min.

Concept
Social decisions influence the availability of energy resources.

Objective
Given the opportunity to share in the distribution of an energy "resource," the students will understand that some energy resources are nonrenewable and that their use is limited by social decisions.

Materials
NEF energy poster on natural gas, oil, coal. M&Ms (or other small pieces of candy)

Implementation

1. Count out enough M&Ms (or other small pieces of candy) so there is one per student. Put them in a paper sack. Save the remaining M&Ms.
2. Discuss the NEF energy posters (dealing with oil, natural gas, and coal) with the students. While this discussion is taking place, pass around the sack of candy, *without rules* on how many pieces students can take. Occasionally adding 4 or 5 M&Ms to the sack. The sack will be empty before it reaches all the students.
3. Point out that fossil fuels have limits just like the M&Ms. Emphasize that fossil fuels are nonrenewable, that they are being consumed faster than nature can replace them. Talk about how much harder students would have to search the room to find the rest of the M&Ms. What if the rules did not allow students to leave their desks? Point out that natural gas, coal and oil companies are looking harder for more resources. What effect did the availability of M&Ms have on the relationship between students? What effect might the availability of fossil fuels have on the relationship between nations, people, states; standard of living and quality of life?
4. Now pass out the remaining M&Ms. Should there be rules established? Do oil, coal, and natural gas companies have rules (regulations) that they must follow to find resources? Should there be rules and regulations on how much oil, coal or natural gas people use? How does the class's social decision influence the availability of M&Ms?

Suggested Assessment
How might social decisions influence the amount of energy available to people?

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Activity No. 9

Science
Art, Language Arts

future | grade | time

"Conserve Today for Tomorrow"

3

60 min.

Concept
Energy availability will affect future lifestyles and cultural conditions.

Objective
Given the opportunity, the student will identify at least four ways in which he/she can conserve energy in order to make it a future energy source.

Materials
Drawing paper
Farewell to Shady Glade, by Bill Peet
Water colors, crayons

Implementation

1. Read *Farewell to Shady Glade* by Bill Peet. Discuss the fact that we are using up land.
2. Ask the following questions:

   What other things are we using up? (*Energy* should come from students.) Can we save energy? What will happen if we use up all of our energy? What things will we not be able to do?
3. Follow discussion by suggesting four areas in which a student could save energy: Home, school, community, shopping. Ask students how they might save energy in these areas. How does this affect what they can do?
4. Have students paint or draw a picture about how he/she can save energy in each of these categories.

Suggested Career Awareness Activity
Make a list of 3-5 workers on the board. Discuss the kind of work they do. Try to determine which job or jobs require more physical energy output. Lead the students to identify ways that some of this physical energy could be saved.

Suggested Assessment
Have students write a paragraph about how their life would change if electricity was no longer available for them to use.

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Activity No. 10

Science
Art, Language Arts

conservation | grade | time

"Helping Hands"

3

5-30 min.

Concept
There are various methods to conserve energy

Objective
Given the opportunity to complete a booklet, the student will be able to state one method of conserving natural gas, coal, food, wood, sun, electricity, oil, and water.

Materials
Student handouts, cut by teacher to make a booklet
Stapler
Blank paper
Construction paper for "Helping Hands"
Felt markers or crayons
Large symbols (or magazine pictures) of each energy source for bulletin board

Implementation

1. Tell the students they will play a guessing game. Pass out pages 1 and 2 of booklet.
2. Read page 1. Students can take turns reading orally. They can then guess what the energy source is and write its name in the "I am" box.
3. Discuss the questions asked before drawing the picture. When discussion is over, the picture can be drawn.
4. Follow the same procedure for the remaining pages.
5. When students have finished all the pages, staple them together to make a booklet. Put a blank sheet on the front which students can decorate. The title can be, "What Am I?"
6. Remind the students that as each page was completed they discussed how they could help the source last longer or assist the source in helping more people. Ask them to keep the discussions in mind for the next step.
7. Have the students trace one hand onto a piece of construction paper. Each student should pick an energy source that he/she would like to help. On the hand, have the student write how he/she could help. For example, if the source chosen is oil, the student could make fewer trips to the store, walk to a friend's house, etc. Use markers or crayons so that writing will show up. Cut out hands.
8. Put pictures of energy sources on bulletin board, and title it "Helping Hands." Have each student put his/her hand next to the energy picture he/she is helping.
9. Discuss students' "Helping Hands."

Suggested Career Awareness Activity
Survey the class to see how many parents work in a job directly related to these energy sources.

Suggested Assessment
Have students list one way to conserve energy for four energy sources/form.

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HELPING HANDS

(1) I AM

I am used in cars.
I am a liquid.
I come from crude oil.
People pump me through a hose.
Cars and trucks need me to run.
People use too much of me.
How can I help more people?

DRAW A PICTURE OF ME.

(2) I AM

I am black and shiny and hard.
I am burned for heat.
People mine for me deep in the ground.
I am very old!
I come from ancient plants.
How can I help more people?

DRAW A PICTURE OF ME.

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7:

(3) I AM

You like me!
I give you energy.
I can be an apple, a hamburger, or a birthday cake.
You need me to grow.
What can be done to be sure there will be plenty of me for everyone?

DRAW A PICTURE OF ME.

(4) I AM

I am so important!
I am used for many things.
People burn me in a fireplace to keep them warm.
I make lovely furniture, and I am used to build houses.
What can be done to be sure there will be plenty of me for everyone?

DRAW A PICTURE OF ME.

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(5) I AM

I give heat and light.
I make the day warm.
I help plants grow.
I give you a tan.
Please think of ways that I could help more people.

DRAW A PICTURE OF ME.

(6) I AM

Light bulbs need me.
Without me the T.V. will not work.
I am a "powerful" thing!
I am a form of energy.
I am made by the burning of coal, oil, or natural gas.
How can I help more people?

DRAW A PICTURE OF ME.

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(7) I AM

Gasoline is made from me.
Some people use me to heat their homes.
I can help fix a squeaky door.
How can I help more people?

DRAW A PICTURE OF ME.

(8) I AM

I am very wet.
People dam me up so I can make electricity.
I am good to drink.
I cool you in summer and help keep you clean.
How can you help me?

DRAW A PICTURE OF ME.

(9) I AM

I heat homes and water.
I am not a solid.
I move through pipes.
I cannot be seen.
I am made smelly for your safety.
How can you use me more wisely?

DRAW A PICTURE OF ME.

(10) I AM

I am sometimes used to make electricity.
I make up all things.
I am split to make heat.
How can you help me?

DRAW A PICTURE OF ME.

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Activity No. 11

Language Arts
Science, Art

conservation | grade | time

"Create a Commercial!"

3

4-30 min.

Concept
There are various methods to conserve energy.

Objective
Given the opportunity to discuss examples of energy waste, the student will create a commercial to encourage reduction of energy waste.

Materials
Paper
Felt tip pens

Implementation
1. Divide the class into groups of four.
2. Tell the class that in these groups they will be given the opportunity to write a commercial which will encourage people to reduce their waste of energy.
3. Have the class chart examples of each type of energy waste.
4. Give each group a paper and pen. Tell them to discuss and then record ideas for their commercial on the paper you provided.
5. Once the students' ideas are established, allow time for them to create a commercial format.
6. Encourage the students to practice and prepare to present their commercials for the rest of the class and perhaps to other classrooms.
7. Have students present their commercials.

Optional Activity
Invite someone from your district skilled in videotaping to train selected students in the use of that machine. Give the students the opportunity to have their commercials videotaped.

Suggested Career Awareness Activity
Invite someone from a local advertising agency to talk about his/her job and about commercial development.

Suggested Assessment
List four ways people can conserve energy.

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ENERGY

Multidisciplinary activities for the classroom developed by The National Energy Foundation especially for teachers

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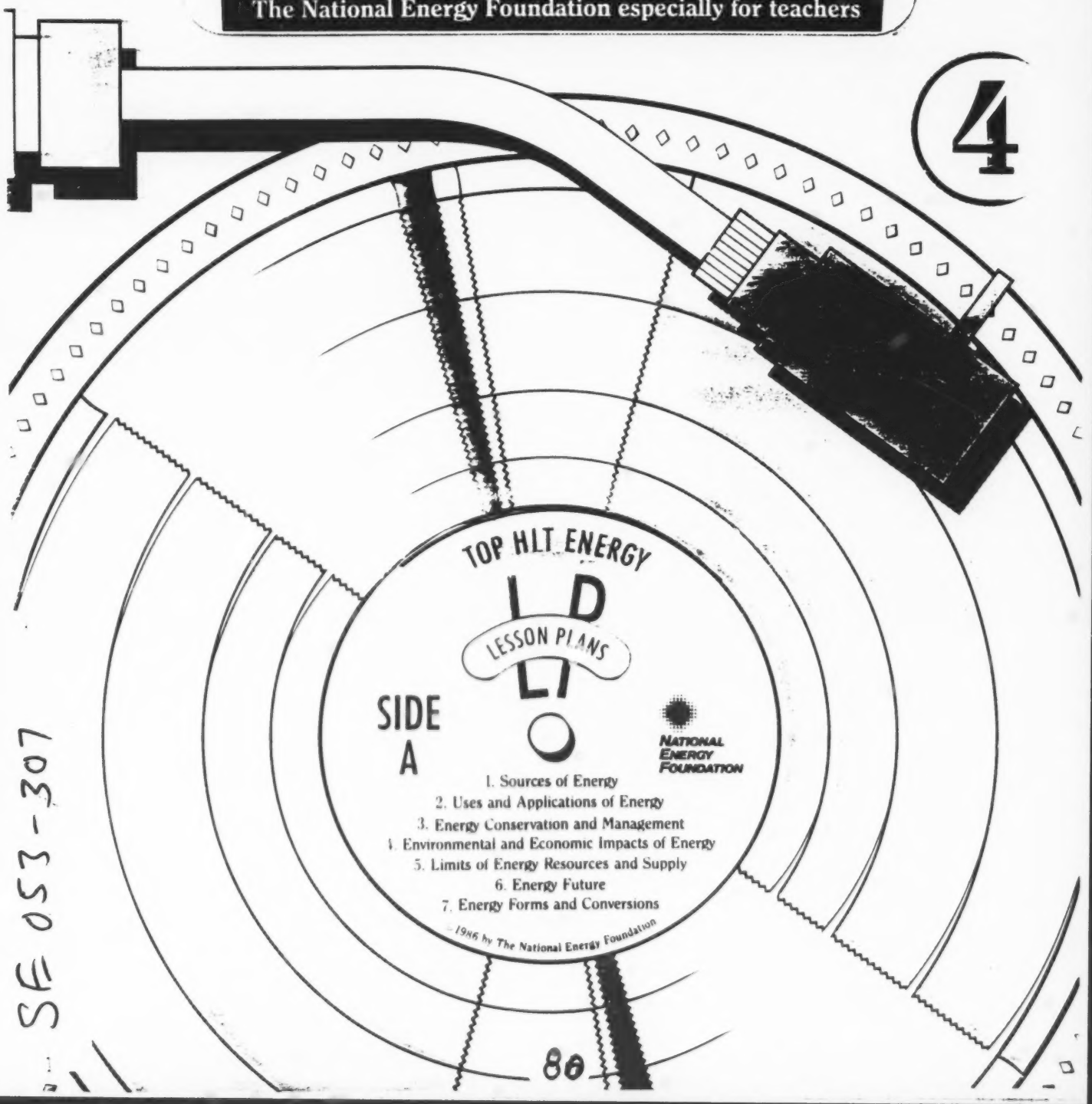

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NATIONAL ENERGY FOUNDATION
Resources for Education

About the National Energy Foundation

The National Energy Foundation (NEF) is a unique nonprofit educational organization devoted to the development of instructional materials and teacher and student educational programs dealing with energy. NEF is supported by resources from business, government and education. NEF's primary concern is to present energy, science, technology and contemporary issues accurately and objectively.

To the Teacher

NEF instructional materials are teacher-developed, teacher-tested and multidisciplinary. The instructional materials are developed in accordance with NEF's **Conceptual Framework**. The seven goal areas of the **Conceptional Framework** are: Sources of Energy, Uses and Applications of Energy, Energy Forms and Conversions, Environmental and Economic Impacts of Energy, Limits of Energy Resources and Supply, Energy Future, and Energy Conservation and Management. Each goal area is then divided into concepts which are necessary to a fundamental understanding of energy. Listed under each concept are simply stated objectives.

About the Elementary Lesson Plans

The enclosed elementary lesson plans and activities have been selected as those most preferred by teachers and students. They have been designed for use within NEF implementation workshops. Included within each of the activities is a complete breakdown as to the time needed for implementation, materials required, implementation procedure, assessment questions, student handout masters (for duplication), identification of optional activities or career education suggestions and other information pertaining to the successful completion of the activity.

Warning: some of the activities are potentially hazardous due to the use of flammable substances and/or heat. Please exercise extreme caution. Check your local and state laws governing the use of flammable materials in the classroom. In addition, always be alert to possible electrical hazards. Each school year should begin with a review of the safe use of electricity, and each activity involving the use of electricity should be preceded by a reminder of safety procedures.

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NATIONAL ENERGY FOUNDATION
Resources for Education

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Activity No. 1

Science
Art

sources	grade	time
	4	60 min.

"Energy From the Sun"

Concept
The sun is the primary source of the earth's energy.

Objective
Given the opportunity to experiment, the student will demonstrate how different materials either reflect or absorb solar radiation.

Materials
Boxes
Thermometers
Black paper and possible other colors
Aluminum foil

Implementation

1. Have the students line two boxes of similar size with similar lining material. One box should be covered with aluminum foil. A thermometer is placed in each box and a comparison is made of the temperature. The comparison should be made after 30 minutes. Be sure each box is exposed to equal sunshine.
2. During and after the experiment, discuss the following questions with students.
   A. Questions for discussion during experiment. You may wish to record student responses on chalkboard.
      1. Have students predict what will happen to the temperature within each box.
      2. Have students write an explanation for their prediction.
   B. Questions for discussion after experiment. Record the temperatures of the boxes on the chalkboard.
      1. Ask students which prediction(s) were correct, and which explanation most closely explains the correct prediction.
      2. Ask students why they think it was necessary to have the same size boxes, inside lining, and equal sunshine.
      3. Where did the heat inside the boxes come from, originate?

Optional Activities

1. Line box with black paper and cover with black paper. Line box with aluminum foil and cover with aluminum foil.
2. Use different colors and different textures of covering and lining material.

Suggested Career Awareness Activity
Ask students to study jobs that could result if we were to become dependent upon solar energy.

Suggested Assessment
Match the Following:

___ 1. Absorb
___ 2. Reflect
___ 3. Solar
___ 4. Radiation
___ 5. Thermometer
___ 6. Black
___ 7. Light colors

A. Increase in temperature
B. From the sun
C. A device for measuring temperature change
D. To collect solar heat
E. A form of energy transfer
F. Very little increase in temperature
G. To give off solar rays

Answers

1-D, 2-G, 3-B, 4-E, 5-C
6-A, 7-F

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Activity No. 2

Language Arts
Science

sources	grade	time
	4	60 min.

"Balloon Talk"

Concept
Natural and human processes are constantly forming energy sources.

Objective
When given background information about natural gas formation, exploration, drilling, pipeline construction, distribution, and storage, the student will be able to describe the processes for each by writing "Balloon Talk" captions for the pictures provided.

Materials
Natural Gas Vocabulary Worksheets
Balloon Talk Worksheets
Natural Gas Reading

Implementation

1. The teacher will list on the blackboard vocabulary words which appear in the background information and discuss the pronunciation and meaning of each word with the students.

natural gas	city gate
gas	valves
liquefied	synthetic fibers
geologist	meter
organic	mercaptin
drill	

   As an extension of this activity, the teacher should have the students complete the vocabulary worksheet provided. Upon completion by the students, correct and discuss the worksheet assignment.

   Answers for Natural Gas Vocabulary Worksheet

   I,C,G,D,A H,E,J,F,K,B

2. The teacher will duplicate and distribute the Background Information for student reading. (Based upon student ability, the teacher should decide how best to conduct the reading assignment.)
3. Once the students have completed the reading assignment, the teacher should distribute the "Balloon Talk" worksheets. Indicate that the pictures tell the story about natural gas.

   The teacher will instruct students to observe each picture and infer its meaning. The captions for the narration have been omitted. The students are to fill in the captions based upon what they learned from the reading assignment.
4. When the captions are completed by the students, the teacher should have them share and discuss their original creations with the class.

Suggested Assessment
Match the following:

____ 1. Synthetic Fibers
____ 2. Natural Gas
____ 3. Geologist
____ 4. Meter
____ 5. Valve
____ 6. Gas
____ 7. City Gate
____ 8. Drill
____ 9. LNG
____10. Organic
____11. Main
____12. Hollow Log

A. Compounds of hydrogen and carbon
B. Device that regulates amount of gas that passes
C. Shapeless fluid (air)
D. Gas in a liquid state
E. Methane
F. Early pipeline
G. Where gas pressure is lowered
H. One who studies rocks
I. Main part of gas distribution system
J. To bore through the ground
K. Device that measures gas volume
L. Artificial cloth

Answers

1-L, 2-E, 3-H, 4-K, 5-B, 6-C, 7-G, 8-J, 9-D, 10-A, 11-I, 12-F

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Activity No. 2

"Balloon Talk"

NATURAL GAS VOCABULARY WORKSHEET

Name: _____ Date _____

DIRECTIONS: Match the natural gas term with the correct definition by placing the letter in the blank provided.

A. organic
B. natural gas
C. gas
D. liquefied
E. geologist
F. drill
G. city gate
H. meter
I. synthetic fibers
J. valve
K. mercaptin

____ Artificially made or man-made cloth for use in clothing.

____ A shapeless fluid in the form of air. Commonly refers to natural gas fuel. Can be a single ingredient or a mixture. Does not refer to atmospheric air. Also a short term for gasoline.

____ The local station that lowers natural gas pressure from the pipeline to the local gas company and measures the amount of gas used. Also removes any impurities picked up in the pipeline and adds odorant.

____ To reduce to a liquid state—flowing freely like water.

____ Composed of or relating to carbon compounds, particularly hydrogen and carbon. Generally derived from living organisms as opposed to inorganic or mineral.

____ The device at the customer's site that measures and records the volume of gas used.

____ A scientist who deals with the earth's surface of rock and non-living associated matter.

____ A mechanical device used to start, stop or regulate a passageway or port in the transport of natural gas.

____ To bore through the ground with a bit and attached pipe to reach a deposit. Generally done with rotary equipment.

____ The odorant added to natural gas for safety.

____ Odorless, colorless, tasteless, nontoxic, clean-burning fossil fuel, largely methane (CH_4), a naturally occurring hydrocarbon that can also be produced synthetically, such as by coal gasification.

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Activity No. 2

"Balloon Talk"

NATURAL GAS

Name: _____ Date: _____

How Natural Gas is Formed

A long time ago, before people lived on earth, it was covered with many tiny plants and animals. Some lived on land, some in the water. As the animals died on the land, they were covered with leaves falling from the trees, dirt blowing in the wind, and rain falling. Sometimes they were washed into the water. As the animals in the water died, they were covered by sand and mud and underwater plants that died. After a long time, the plants, animals and dirt all mixed together. This new material was called organic matter. The sand and dirt and mud that covered the organic matter turned into rock. Many layers of organic matter and rock were formed in this way. Later, heat and the weight from rocks above changed the organic matter into natural gas. This natural gas stayed under the heavy rock. Sometimes when there was a small crack in the rock, the natural gas would go up through the crack to the top of all the layers of rock and soil and mix with the air on the surface of the earth. When mixed with air and heat, natural gas can burn. Sometimes people saw natural gas burning on the surface of the earth or on top of the water. Most of the time there were no cracks in the rock and the natural gas stayed trapped deep underground. There are still many layers of natural gas under the ground today.

How Workers Explore for Natural Gas

Many years ago people saw a small flame on the surface of the earth. They wanted to find out how and why this was happening so they began to dig. They dug a deep hole near the flame to help more natural gas come to the surface. By doing this, the flame got larger. When the people put a cover over the hole the flame went out. They learned that whatever was burning was coming from the hole... even though they could not see, touch, smell or hear it. They put hollow logs together in a long line to make the natural gas go where they wanted to use it. When the natural gas came out at the end of

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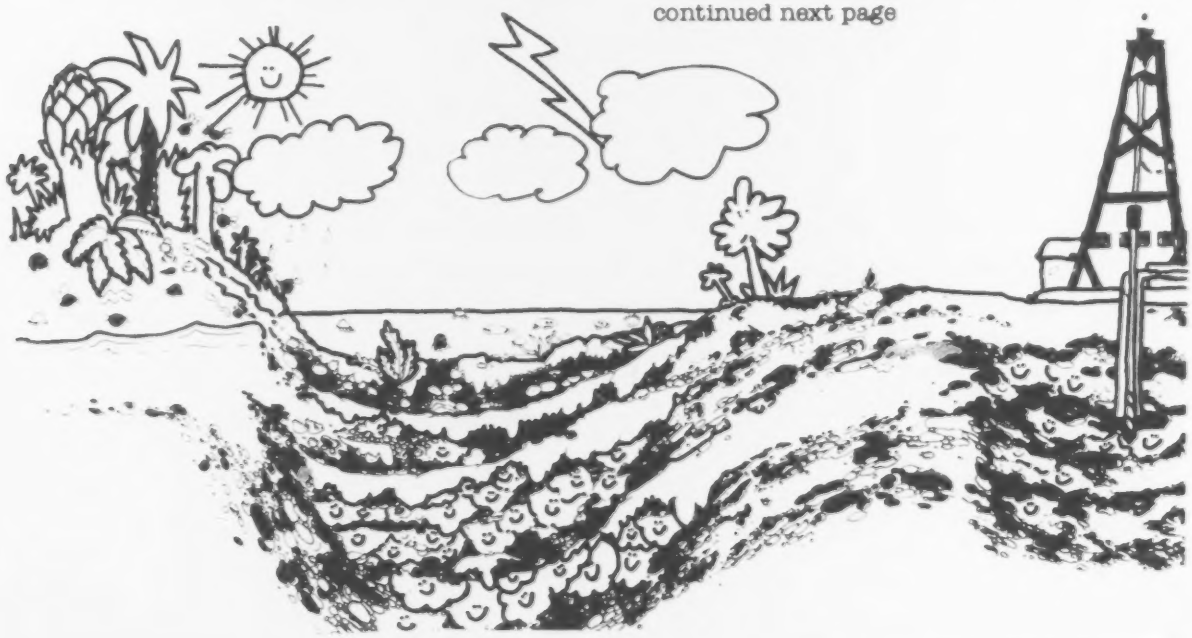

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the logs, they lit it and used the flame for light and heat for their streets and homes.

There are many places in the United States where natural gas may be found under the earth. People try to find these places and help the natural gas get to the surface of the earth. These people are called "geologists." One of the ways geologists discover natural gas is to look at rocks and soil on the surface of the earth. There are many kinds of rocks. When the geologist finds a certain kind of rock and soil that is usually found near natural gas, s/he will dig a hole to see if the natural gas is there.

How Natural Gas is Transported for Use in Homes, Schools, Businesses and Industry

After the drills dig the holes and bring the natural gas to the earth's surface, the natural gas is cleaned. The gases and oil are then separated and put into different holding tanks. After the natural gas is cleaned, it is taken to where it is burned by people to heat their homes, schools, businesses and factories. There are many ways to do this. One way is to help the natural gas into long pipes—just like the hollow logs that were used a long time ago. Today, these pipes are made of metal and plastic. There are many pipes carrying natural gas all over our country. Natural gas is transported in thousands of miles of pipeline put underground. If all the pipes were stretched out in a straight line, they would go as far as to the moon and back to the earth more than two times!

The natural gas is measured and sent in the underground pipeline to homes and other buildings at the "city gate."

The equipment at the city gate does many jobs:

1. The natural gas is measured.
2. More smell is added to the natural gas so that if any leaks out, it can be found. The smell is caused by mercaptin.
3. The natural gas is put into smaller pipes.
4. Extra natural gas that was saved in the summertime can be added.

After passing through the city gate, the natural gas enters the pipes that take it closer to the homes and other buildings in the community. These pipes are called gas "mains." There are "valves" with handles along the way, so that in case of a fire or flood in the city, the natural gas can be stopped in the pipes until it is safe to turn on again.

When the natural gas arrives through the natural gas main, it enters an even smaller pipe to travel into each building. Each building also has a valve so that the supply of natural gas may be turned off and on without stopping the supply to neighbors. When the natural gas enters a building, it goes through a meter to be measured. A "meter reader" comes to the building every month to read the numbers on the meter. These numbers tell how much natural gas has been used and must be paid for.

Using and Storing Natural Gas

Many buildings use natural gas to heat themselves, to heat water and make things to sell in the community. It takes energy from natural gas to make cereal, bake bread and cook food before it is put into cans. It takes energy from natural gas to make steel. Natural gas is used to make fertilizer so farmers can grow more corn and tomatoes. It is also used to make "synthetic fibers" for some of the clothing we wear. Perhaps natural gas heats your school. Natural gas can provide energy to do many other jobs. It melts glass and generates heat for pasteurizing milk. The barber shop, the grocery store, the beauty shop, the office buildings may all use natural gas to help make your community a more comfortable place to live.

In the wintertime, when it's cold, more natural gas is needed to heat homes and buildings. During the summertime when we do not use very much natural gas, the company that pipes the natural gas to your house stores it in underground tanks. In the wintertime, when more natural gas is needed, this stored natural gas can be quickly added to the natural gas in the pipelines. When natural gas is stored, it is changed into a liquid by making it very cold. When natural gas is changed to a liquid, it gets smaller, and is called liquefied natural gas (LNG). LNG can be saved in big tanks near the communities where it will be used.

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BALLOON TALK

Name: _____ Date: _____

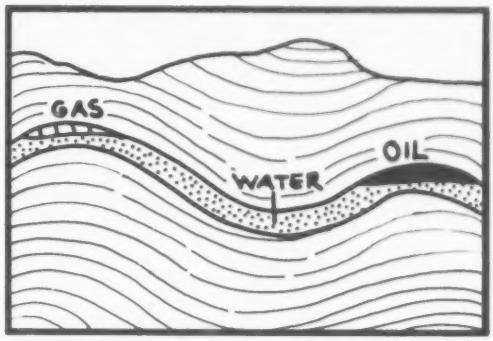

Figure 1
Formation of Natural Gas

Figure 2
Exploring For Natural Gas

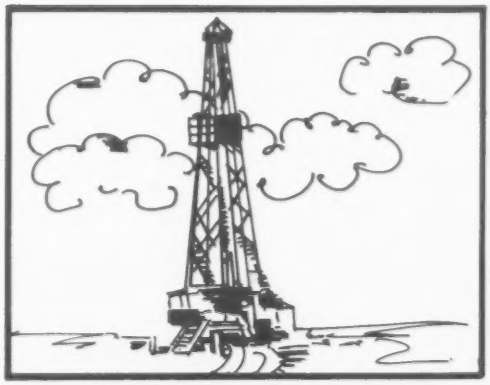

Figure 3
Drilling for Natural Gas

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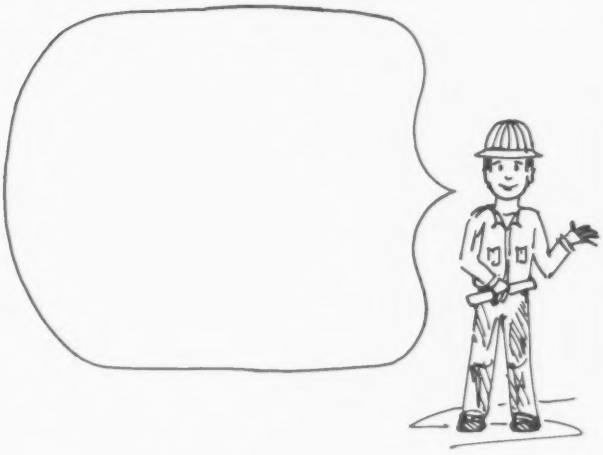


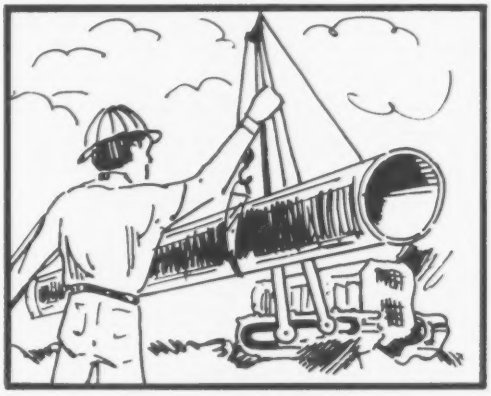
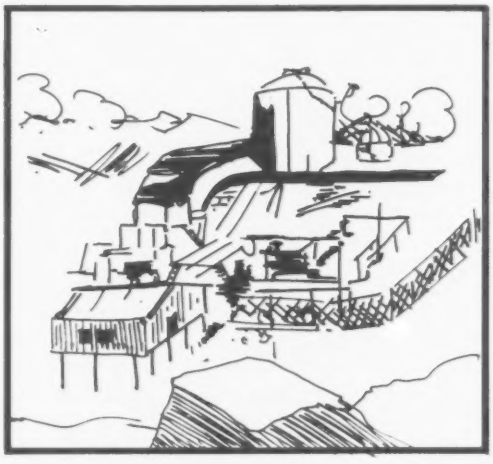


Figure 4
Transporting Natural Gas



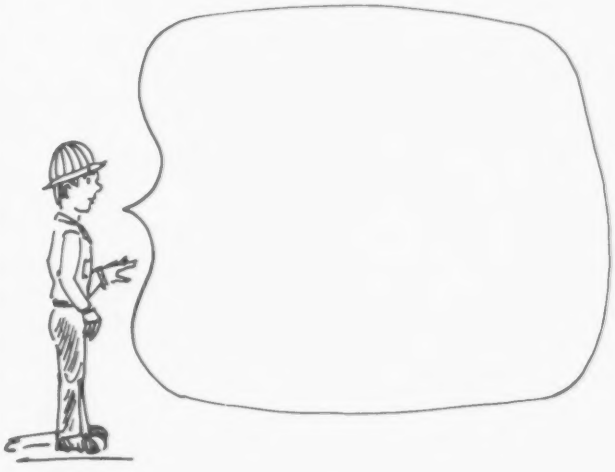


Figure 5
Storing & Using Natural Gas

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Activity No. 3

Language Arts
Science

sources | grade | time

"Questioning 'Yes or No?'"

4

30 min.

Concept
Energy sources can be classified in many different ways.

Objective
Given the opportunity, the student will be able to use the inquiry process as one technique for obtaining data about energy sources.

Materials
Felt pen
3" x 5" cards

Implementation

1. On 3" x 5" cards, write the following energy sources. (One on each card.)
   1. Coal
   2. Oil
   3. Sun (Solar)
   4. Gasoline
   5. Wood
   6. Nuclear
   7. Ocean Current
   8. Geothermal
   9. Hydro
   10. Natural Gas
   11. Garbage
   12. Wind
   13. Plants
   14. Oil Shale
   15. Tar Sands
   16. Ocean tides

   You can duplicate each source of energy to have enough for a class size of 32.

   You may wish to preview the list of sources and discuss with students before beginning the activity. You may also wish to delete or add words such as fission or fusion.

2. Explain the rules of the activity:

   A. You may ask only 3 questions per person.

   B. Questions can be answered with only **yes** or **no.**

   C. Place the cards on the backs of everyone in the room and allow them to ask their questions. If anyone identified their energy source, they are to continue to answer questions for the others.

   D. If a person has identified their energy source, take their card off their back and put it on their chest.

3. After 20 minutes, stop the activity and have the students place their cards on their chest. Then have them group themselves according to similar energy source or other characteristics. Have each group explain how they have grouped themselves.

4. Finalize activity by going over each energy source with students.

Optional Activity
Determine those energy sources that are not located in your area.

Suggested Career Awareness Activity
As a class, list the energy sources used in your local area and name two occupations that work directly with that source. (e.g., coal = coal miner)

Suggested Assessment
Select the best answer:

1. Coal is:
   A) a fossil fuel
   B) a renewable source of energy
   C) a product of oil
   D) a liquid

2. A substance that usually occurs naturally as a black liquid is:
   A) coal
   B) oil
   C) gasoline
   D) geothermal

3. The sun:
   A) is a fossil fuel
   B) occurs underground
   C) is an energy source
   D) can be converted into oil

4. Gasoline is:
   A) a solid
   B) a product of geothermal
   C) naturally occurring
   D) a product of petroleum refining

5. Geothermal energy:
   A) is found everywhere
   B) is a fossil fuel
   C) is formed from oil
   D) is from the earth

6. A colorless, odorless gas is:
   A) gasoline
   B) natural gas
   C) garbage
   D) nuclear

7. A radioactive energy source is:
   A) garbage
   B) tar sand
   C) oil
   D) nuclear

8. A solid, renewable energy source that burns is:
   A) tar sands
   B) coal
   C) wood
   D) oil

9. A nonrenewable energy source is:
   A) wind
   B) ocean currents
   C) plants
   D) oil shale

10. All of the following are fossil fuels except:
    A) oil
    B) oil shale
    C) tar sands
    D) geothermal

Answers
1-A, 2-B, 3-C, 4-D, 5-D, 6-B, 7-D, 8-C, 9-D, 10-D

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Activity No. 4

Social Studies
Mathematics, Language Arts

uses | grade | time

"Our Leisure Time Activities"

4

30 min.

Concept
Every energy use decision affects standards of living and quality of life.

Objective
Given the opportunity to participate in a values clarification exercise, the student will be able to become more aware of the relationship between standard of living and energy use.

Materials
Paper
Pencil
Our Leisure Time Activities Worksheet.

Implementation

1. Ask each student to make a list of five leisure time activities that s/he enjoys doing.
2. Rank in order each activity from the most important to the least important.
3. Next to each item, place a $ (dollar sign) if the activity costs money each time it is performed.
4. For each item, assign an Energy Point Value:
   3 points if a major amount of energy is used.
   2 points if a moderate amount of energy is used.
   1 point if very little energy is used.
   0 points if no artificial energy source is used.
5. For each item, assign an Activity Use Value:
   3 points if the activity is performed a lot.
   2 points if performed occasionally.
   1 point if performed seldom.
   0 points if never done.
6. Multiply the Energy Point by the point assigned to the Activity Use. Add an additional point for each activity with a $ sign. Indicate the total in the column labeled Total Value.
7. Assume that a severe energy shortage now exists and that all people must conserve as much energy as possible. Cut back your leisure time activities so that your point value total is reduced by at least 50%!
8. Retotal the Total Value points after making reductions in the Amount of Use.
9. Class Discussion:
   A. Are you willing to reduce by 50%? (Why or why not?)
   B. How did you conserve energy? Which items did you reduce?
   C. Does your priority ranking affect your decisions? If so, how?
   D. Does the $ value have any affect on energy usage?
   E. What types of activities can we do that are fun and do not require much use of energy sources?

Suggested Assessment

1. Write a story on "The Day The Energy Ran Out." Answer how it affected your leisure time activities.
2. List 5 ways that you could conserve energy in leisure time activities.

ILLUSTRATION OF ACTIVITY—FOR TEACHER USE ONLY

ACTIVITY	RANKING	$	ENERGY POINT	ACTIVITY USE BEFORE	ACTIVITY USE AFTER	TOTAL VALUE BEFORE	TOTAL VALUE AFTER
Water skiing	2	$	3	1	1	7	7
Guitar	1	$	0	3	3	0	0
Sailing	4	$	1	2	1	3	2
Motorcycle racing	5	$	1	3	2	4	3
Snow skiing	3	$	2	2	0	5	0
					TOTAL POINTS	19	12

Before = Before making a reduction in use.
After = After making activity use reduction.

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OUR LEISURE TIME ACTIVITIES

Name: _____ Date: _____

TOTAL POINT VALUE

To obtain the Total Point Value, multiply the Energy Point Value by the Activity Use. Add 1 point for each activity with a $ sign. (Remember, zero times any number equals zero.)

EXAMPLE:

Activity	Energy Point	x	Activity Use	+ $ =	Total Value
Flying	3	x	2	+ 1 =	7

Activity	Ranking	$	Energy Point	Activity Use Before	Activity Use After	Total Value Before	Total Value After
1.							
2.							
3.							
4.							
5.							

Total Points _____

ENERGY POINT VALUE

Points	Amount
3	If a major amount of energy is used
2	If a moderate amount of energy is used
1	If very little energy is used
0	If no energy is used

ACTIVITY USE VALUE

Points	Amount
3	If done a lot
2	If done occasionally
1	If done seldom
0	If never done

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Activity No. 5

Language Arts
Science

"Subject and Predicate Cards 'Mix and Match'"

uses	grade	time
	4	30 min.

Concept
Each form of energy can be used in many ways.

Objective
Given the opportunity, the student will be able to gain information about energy use by matching subject phrases with predicate phrases.

Materials
32 3" x 5" cards
Markers

Implementation
1. Prepare 2 sets of cards. One set should be a different color than the other. On one set of cards, place the subject phrases of a complete sentence on each card. Place the predicate phrases on the cards of the other color. Complete all the cards using about 16 sentences. Sentences can be about energy sources, uses, occupations, etc. See sample cards below.
2. Pass cards to the students.
3. Have the students move to each other, comparing cards, until all cards are matched. Students will then read their matches and identify the subject phrase and predicate phrase.
4. Have students write a new predicate phrase for one of the subject phrases.

SAMPLE CARDS

1. A plant	uses the sun's energy.
2. Solar energy	is a renewable energy source.
3. Gasoline	is refined from petroleum.
4. A scientist	discovers new energy sources.
5. A dam worker	uses water to produce energy.
6. The sun	is the primary source of energy.
7. A house	uses a furnace.
8. Nuclear power	is a source of energy used to produce electricity.
9. A car	uses oil to help it run.
10. Geothermal energy	is found under the ground.
11. A river	can be polluted.
12. A mine worker	works underground.
13. Energy	is converted.
14. Natural gas	is a fossil fuel, mostly methane.
15. Electricity	is made by a generator.
16. Coal	is formed from ancient plants.

Note: Often correct matches can be made in more than one way.

Suggested Assessment
Match the Following:

____ 1. Source of energy
____ 2. Underground
____ 3. Furnace
____ 4. Generator
____ 5. Renewable
____ 6. Conserve
____ 7. Polluted
____ 8. Fossil Fuel
____ 9. Electricity
____10. Geothermal
____11. Gasoline
____12. Sun

A. To use efficiently
B. Natural gas
C. Energy that can be used to do work
D. Converts an energy source to heat
E. Deep mines
F. Can make electricity
G. Can be formed again in a short time
H. Source of solar power
I. Contains unwanted substances
J. Produced by a generator
K. A form of energy used by many people in cars
L. Heat from the earth

Answers
1-C, 2-E, 3-D, 4-F, 5-G, 6-A, 7-I, 8-B, 9-J, 10-L, 11-K, 12-H

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Activity No. 6

Science
Art

conversions	grade	time
	4	5-30 min.

"Wet, Windy and Steamy"

Concept
There are human made and natural energy conversion systems.

Objective
Given the opportunity, the student will construct a model water wheel, steam turbine and windmill, and will state how these might be used (full scale) to run a generator to produce electricity.

Materials
Electrical Generation Worksheet and materials to complete the investigations. See worksheet for list of materials for each investigation.

Class Activity:
- Faucet and hose if available; if not use a large pitcher of water
- Tub or receptacle to catch falling water
- Burner or stove
- Tea kettle or pan with lid
- Model water wheels and steam turbines made by students in investigations.

Implementation

1. Provide students with copies of the three investigations: "The Power of Water," "The Power of Steam," and "The Power of Wind." Have the students complete each investigation.

2. Review with the class the findings of their investigations with water, steam and wind. Ask if any came up with ideas for how water or steam might be used to generate electricity. Allow time for discussion. Ideas by children can be put on the board for the class to discuss and evaluate.

   A. Discuss with the children the energy conversions that take place in the water and steam investigations. Remind them that the purpose of these investigations is to come up with a way to generate electricity. They should realize that in order to generate electricity,they must convert energy from one form to another. For example, in the steam experiment, there are several conversions that take place:

   - Electrical to thermal (the stove heats the water)
   - Thermal to physical (water boils to steam)
   - Physical to mechanical (steam turns the turbine)
   - Mechanical to electrical (turbine runs generator)

   Talk about energy that must be put into the system in order to come up with electricity.

   B. Discuss the wind investigation. Ask children to compare this method with each of the others. What might be possible advantages?

3. Ask for volunteers to help with an experiment. One child will hold a hose over a tub or sink and several other children will be needed to hold their water wheels beneath the stream of water.

   A. First experiment with the height of the water. Ask children to observe closely while you place the water wheel in different places under the falling water. Does it seem to make a difference in the speed that the wheel turns?

   B. Next, ask children whether they think we are using all of the power of the water to turn the water wheels. Could we turn more than one?

   C. Have volunteers add their water wheels one by one to the stream of water to see how many wheels they can turn with the water. Does the speed of the wheels turning change by adding more wheels? When you have as many wheels turning as possible, ask children if they are now using all of the power available. How do they know?

   D. Ask: What happens to the water that is not being used to turn the wheels? Where does it go? Is there any way that this water can be used again? How? Ask how many children have visited a dam where a power plant is located. What happens to the water once it goes over the dam?

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4. Heat water in a tea kettle and use the same procedure as with the water wheels, using the steam from the kettle and the model turbines built by the children.

   A. Ask: Are we using all of the steam available to turn the turbines? How do you know? You might have a child hold his/her hand above the turbines to see if he/she can feel steam as evidence that steam is escaping.

   B. Ask: Is the wasted steam wasted energy? What happens to the steam that is left over? Is there any way that we can use this steam to do work for us? Can we re-use the steam? Is there any other kind of energy produced that might be used (heat)? How might it be used? Do you think that either the steam or the heat have any affect on the environment?

Suggested Career Awareness Activity

Invite a local electric utility person to class or someone who has information about steam and wind power generation to demonstrate or discuss how these sources of energy might be used on a large scale.

Suggested Assessment

Choose the correct conversion to fit the example.

A. Electrical to thermal
B. Thermal to physical
C. Physical to mechanical
D. Mechanical to electrical

___ 1. Water boils to steam.
___ 2. A turbine runs a generator.
___ 3. An electric stove heats the water.
___ 4. Steam turns a turbine.
___ 5. Water wheel is turned by falling water.
___ 6. Coal is burned to boil water.
___ 7. Wind turns a windmill.
___ 8. Water from a dam turns a turbine.
___ 9. Atoms give off heat energy during a nuclear reaction to boil water.
___ 10. Steam turns a pinwheel.

Answers

1-B, 2-D, 3-A, 4-C, 5-C, 6-B, 7-C, 8-C, 9-B, 10-C

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ELECTRICAL GENERATION

Name: _____ Date: _____

You probably know that most of the electricity we use is brought to our homes by power lines which carry electric current. Where does the electric current come from? It comes from huge power plants where electricity is **generated** in large amounts for our use. To generate electricity requires a generator, and a generator needs a magnet, a coil of wire and either the magnet or the coil must move.

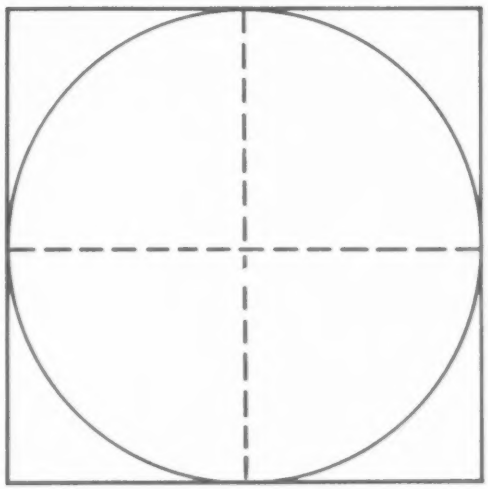
When you generate electricity with a hand generator, you use the energy of your muscles to turn the crank. How are generators in power stations turned?

Here are some simple investigations you can do to see some ways that generators might be turned in a huge power station:

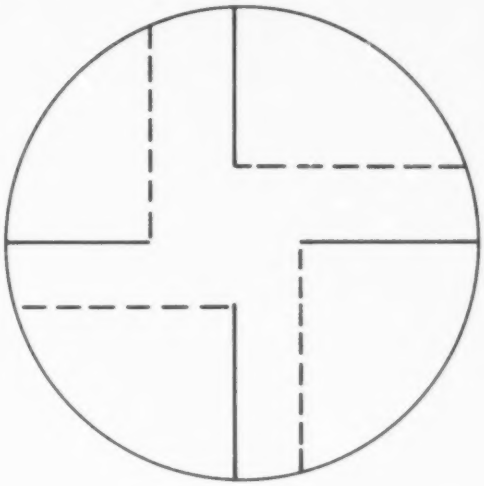
1. **"The Power of Water."** Refer to the Materials Section for a list of needed items. Follow the directions below:

   A. Cut a circle about 10 cm in diameter from the tagboard.

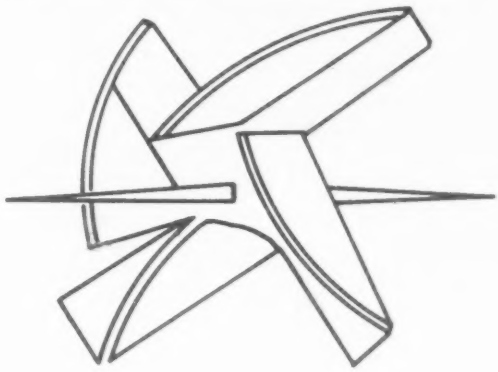
   B. Make two lines on the circle, as shown in the sketch.



C. Cut part way down the lines and bend the flaps.



D. Sharpen the toothpick or match at both ends, then stick it through the center of the circle.



E. Hold the wheel lightly by the ends of the toothpick in one hand so that the points of the toothpick are between your thumb and middle finger.

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F. Hold the wheel under a faucet and slowly turn on the water. What happens to the wheel?

_____

_____

G. Now turn on the water full force. Watch the wheel. Where did it get the power to turn?

_____

H. Where did the water get the power to turn the wheel?

_____

I. Now you can make your water wheel do some work for you by tying a button to one end of a piece of thread and tying the other end of the thread to the toothpick. Now hold the wheel under the running water. What happens to the button and thread?

_____

J. Using what you learned about the power of falling water in this investigation, describe a way that water might be used to generate electricity.

_____

_____

_____

_____

2. **"The Power of Steam."** Refer to the Materials Section for a list of needed items. Follow the directions below:

A. Cut the foil into eight pieces, each 7.5 cm long and 5 cm wide. Fold each piece in half.

B. Staple each piece to the box cover.

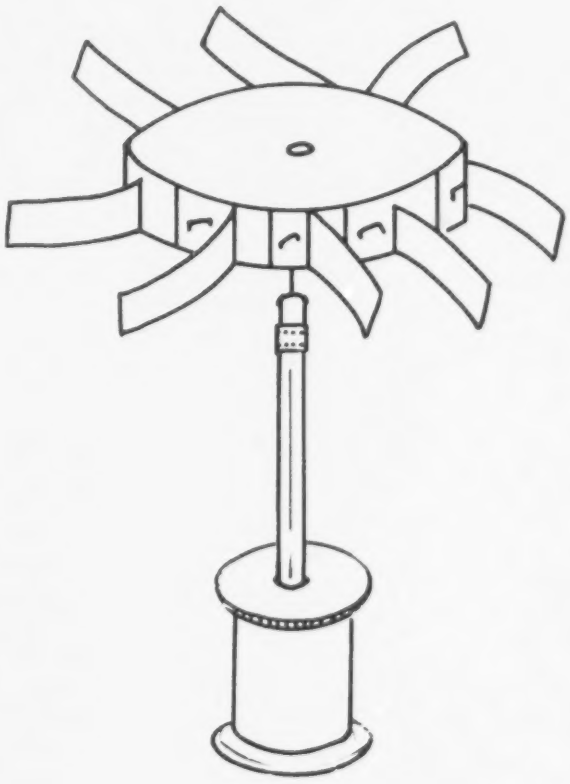
C. Push the eye end of the needle into the eraser of the pencil.

D. Put the box cover on the point of the needle. Experiment until you find the place where the cover hangs straight and even. Make a tiny hole at this place.

E. Push the bottom half of the snap fastener into this hole.

F. Put the point of the pencil into the hole in the spool.

G. Rest the box cover on the point of the needle.



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H. Put some water in a tea kettle or pan with a lid and heat it until it boils. (If you are using a pan with a lid, place the lid slightly off center so that the steam pushes out strongly on one side of the pan.)

I. Hold the device you made by the spool and bring it near the steam from the kettle. What happens?

_____

J. Where does the wheel get the power to turn?

_____

K. Where does the steam come from?

_____

L. Where did the water get the heat that made it boil to make the steam?

_____

M. Where did the heat come from? What was the energy source used to heat the water?

_____

N. Using what you have learned about the power of steam, describe a way that steam might be used to generate electricity.

_____

_____

_____

3. **"The Power of Wind."** Use the device you made in the second investigation. Follow the directions below:

A. Hold your miniature **turbine** in one hand and blow on it gently. What happens?

_____

B. Blow hard on the wheel. What happens_____

C. What makes the wheel turn? Where did this power come from?

_____

D. Using what you have learned about the power of moving air, describe a way that wind might be used to generate electricity.

_____

_____

Materials

The Power of Water
Light weight tagboard or side of a ½ gallon milk carton
Scissors
Toothpick or match
Button
Thread

The Power of Steam
The cover of a round box, such as an oatmeal box
Heavy duty aluminum foil (a piece about 7.5 cm long and 5 cm wide)
A snap fastener, the kind without a hole in the middle
A needle
A pencil with an eraser
An empty thread spool
A stapler
A tea kettle or pan with a lid
A stove or burner

The Power of Wind
The turbine made in "The Power of Steam"

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Activity No. 7

Social Studies
Science, Art, Language Arts

impacts | grade | time

"The Kool-Aid Stand"

4

2-45 min.

Concept
Compromise may be necessary to resolve conflict concerning the environmental impacts of energy use.

Objective
Given the opportunity, the student will prepare an Environmental Impact Statement for the purpose of starting a hypothetical business (Kool-Aid stand).

Implementation
This decision-making activity involves the students in planning a business venture in order to earn spending money (e.g., Kool-Aid stand.) The Kool-Aid stand is an exciting and controversial one to have in regard to environmental impacts.

An Environmental Impact Statement is a plan or statement the students will prepare in order to convince their parents and neighbors that their business will not have a negative impact on the neighborhood environment. The students will present ideas on how to solve the problems their business will bring about, such as noise, litter, traffic control, lawn and shrub damage, blocking sidewalks and many other problems parents and neighbors would be concerned about.

In developing the Kool-Aid stand, your students need to be concerned with the environmental impact of the following:

A. **Plant Site**—Where on the neighborhood street should a Kool-Aid stand be placed; i.e., parent's yard, corner, etc.? (Think of the environmental damage.)

B. **Construction**—Of what material will the stand be made? (Consider visual pollution.)

C. **Purchasing Supplies**—What will you use in dispensing the Kool-Aid and what other things must you buy to make the Kool-Aid? Could the supplies be harmful to the environment? (Litter, etc.)

D. **Manufacturing**—Will the waste be harmful? How will you solve the problem? Where and how will you obtain water?

E. **Advertising**—Litter? Visual pollution?

F. **Traffic Control**—Cars, bicycles, people, noise, fumes, etc.

G. **Plant Clean-up**—What will you do with the daily waste? Cups, soap suds, etc.

H. **Consumer Waste**—Litter? Recycling? Cleaning up after them? Who is responsible—you or the customer?

NOTE: Before doing this, the teacher should send a note home to the parent explaining what the purpose of the activity is and ask them to critique their child's proposal with concern. The actual Kool-Aid stand *does not* have to be carried out.

1. Have the class discuss the notion of hypothetically starting a Kool-Aid stand to make spending money. Inform the class that in starting a business like this they must first convince their parents and neighbors and get their approval for the Kool-Aid stand. In order for them to receive approval, they must complete an Environmental Impact Statement.

2. List the following areas concerned with the Environmental Impact Statement on the chalkboard:

   Plant site
   Construction
   Purchasing
   Manufacturing
   Advertising
   Traffic control
   Plant clean-up
   Consumer waste

   Leave room between items for students' suggestions and ideas.

   Have the students make decisions about each area above. Where will they build the Kool-Aid stand? Why? What harm will the location have on the environment, if any? What will they use to build the stand? Will it be visually polluting?

3. When the class completes the Environmental Impact Statement that they think will convince their parents concerning each area of business, the teacher should list these on a ditto so each student will get a copy to take home for parental approval.

4. Have the students share the results with the class concerning whether their parents were convinced or not and why. During class discussion, revise the Environmental Impact Statement, if needed, and resubmit it to the parents for approval again. Continue class discussion until approval is granted.

Suggested Assessment
1. List at least four (4) things to consider when preparing an Environmental Impact Statement.

2. Why is an Environmental Impact Statement important?

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Activity No. 8

Social Studies
Science, Language Arts

limits | grade | time

"The Word 'Limited'"

4

3-30 min.

Concept
All energy sources have limits to their usefulness.

Objective:
Given the opportunity, the student will determine what is meant by the word "limited" as related to energy resources.

Materials
Notebook paper
Staples and stapler
Pencils
Box of chalk

Implementation

1. The teacher will explain the word "limited" and give various examples of classroom resources that are limited. Once the students catch on, have them give a few examples of classroom resources that are limited.

2. Have the students develop a plan to conserve a limited resource by dividing the class into five (5) groups and assigning each group a resource that is limited in classroom supply. See group situations below.

   Group I.

   The teacher explains to this group that a hypothetical notebook crisis has hit and the resource is soon to run out. Scientists are working hard to find a substitute, but it will take a long time.

   Each student is only allowed to use two sheets of notebook paper for the day. It is your responsibility to develop a plan for the class on how to best use the paper for all subjects requiring written assignments for the day. Also, be able to explain to the class how each member can conserve paper since the resource is limited.

   Group II.

   Pencils are limited—come up with a plan how students can best conserve their pencils.

   The teacher explains to this group that a hypothetical pencil crisis has hit and a conservation plan is needed. Scientists are working hard to find a substitute, but it will take time. List alternatives or substitutes for pencils.

   Group III.

   The teacher explains to this group that a hypothetical water shortage has developed in the town and a conservation plan is needed in the classroom to help save water

   Group IV.

   The teacher explains to this group that a hypothetical chalk supply shortage has developed. Give the group a box of chalk and tell them that this is all that is left for the year. Have them develop a plan how to best use the limited supply of chalk and also to suggest alternatives that could substitute for chalk.

   Group V.

   Staple shortage has occurred. Give the students a loaded stapler and explain that this is all that is left. Have the group develop a conservation plan and list alternatives to take the place of staples since the source is limited.

3. After the groups have developed classroom conservation plans, have them presented to the class bringing in these points:

   A. The source is limited.
   B. Ways to conserve.
   C. Alternative sources that could be used to replace the limited one.
   D. How the conservation plan impacted their standard classroom use of the resource.

4. After the students have made their presentation, they should realize what the word "limited" means. Explain to the class that most energy resources are limited, i.e., coal, oil, gasoline, uranium, natural gas, etc. List the energy source on the chalkboard and through class discussion, determine why the source of energy is "limited." List ways to conserve the energy source, alternatives for replacing it when the source is depleted, and the impact on the standard of living.

Optional Activity
Write a creative story, "The Day The Gasoline Ran Out."

Suggested Assessment

1. A resource is limited if it

   A. exists in large amounts
   B. is available to everyone
   C. is found everywhere
   D. is hard to find more of it

2. One way to "stretch" the use of a limited resource is to

   A. use it right away
   B. conserve it
   C. lower its cost
   D. give it away

3. One way to save a limited resource is to

   A. use more of it
   B. use it faster
   C. replace it with alternative resources
   D. let everyone have some

4. Limited means that a resource

   A. is in short supply
   B. is in large supply
   C. is easily available
   D. is low in cost

Answers 1-D, 2-B, 3-C, 4-A

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Activity No. 9

Social Studies
Science

limits	grade	time
	4	6-30 min.

"Times are Changing"

Concept
The availability of energy resources influences social, political and cultural growth and well-being.

Objective
Given the opportunity, the student will investigate the amount of energy needed by the community over a period of time.

Materials
State map

Implementation

1. Have students study a detailed map of their state. Locate the more populous and industrial areas on the map. Also, have students locate the sites of electrical generating plants, natural gas distribution centers, coal mines, oil fields/refineries, large rivers, forests, etc. What can be discovered concerning the locations of large cities, industry and natural resources? Could there be a direct relationship between the location of the cities and ready access to an energy source? (e.g. Many towns started around streams and/or rivers due to the availability of the water for transportation and for use of the water wheel to generate power.)
   A. Discuss with the students what they think happens when:
      1. The population of an area increases? (The need for energy increases. Therefore, people must either reduce the amount of energy they are consuming, develop a more efficient system, or develop a new source.)
      2. The population of an area decreases? (The demand for energy decreases, therefore increasing the availability of energy for use by the people in that area, or the excess energy may be transported to other areas.)
   B. Discuss what we are doing in the United States to reduce our energy consumption due to increased population growth.
      1. Conserve energy (carpool, use more insulation in homes, recycle, etc.)
      2. Explore other energy sources such as geothermal, solar, nuclear.
2. Have students trace the development of their community and related energy demands from 1800 to the present.
   A. Use available films and/or resource people to show or tell about the early history of the community.
   B. Have the students list the various **sources** and **amounts** of energy used during early community life and compare this with a list of **sources** and **amounts** of energy being used in the present community.
3. Have the students compare the amount of energy consumed in several other cities in their state. Is there a significant difference in energy consumption between large and small cities; between non-industrial and industrial cities? Your local utility can provide you with information on energy consumption.

Suggested Assessment
Write a paragraph describing the relationship between large population areas and energy sources.

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Activity No. 10

Mathematics
Science, Social Studies

conservation | grade | time

"How Much T.V. Do You Watch?"

4

4-30 min.

Concept
Energy conservation practices affect lifestyles, quality of life and standard of living.

Objective
Given the opportunity to become aware of how much television a student watches per week, the student will be able to understand the cost of using the T.V. for that time period.

Materials
How Much T.V. Do You Watch? Worksheet.

Implementation

1. Explain to the students what a watt, kilowatt and kilowatt-hour are.
   A. Watt: A metric unit of power used to measure electricity—the rate at which work is done or energy (electricity) used.
   B. Kilowatt: A metric unit of power equal to 1,000 watts.
   C. Kilowatt-hour (kWh): The amount of energy (electricity) used in kilowatts per hour. 1 kWh = 1kW used per hour or 1,000 watts used per hour.
2. Explain that electric utilities charge people for the number of kWh they use per month. The rate is multiplied by the kWh used plus taxes to determine your monthly electric bill.
3. Inform students that they are going to conduct a scientific experiment. The experiment is to determine how much electricity they use watching T.V. and what it costs for one week.
   A. Have the students keep a record of how long they watch television each day for one week. Start on a Monday and end on the following Sunday night.
   B. At the end of the week, have each student construct either a line graph or bar graph illustrating their results (data). The teacher should make a graph for the entire class.
   C. Now inform students that for each hour they watched T.V., they used 240 watts (.24kWh) of electricity for a black and white T.V. and 350 watts (.35 kWh) of electricity for a colored T.V. Have students construct a graph illustrating the amount of electricity they used each day.
   D. Now have the students determine the cost of watching T.V. by multiplying the kWh by the rate. Your local utility can supply you with your electric rate. You may want the students to construct a graph illustrating the cost of watching T.V. per day.
4. Discuss the relative merits of the programs watched, the electricity used and the cost of watching T.V. Inform the students they are going to repeat the experiment, but this time they are to conserve electricity by reducing the amount of time they watch T.V. Have the students repeat steps 3A through 3D.
5. Compare and discuss the results of both experiments with students. Discuss how their lifestyles, quality of life and standard of living was changed.

Suggested Career Awareness Activity
Ask the students how many careers related to the television industry involve the use of depletable resources.

Suggested Assessment

1. If a person watches 1500 hours of T.V. per year, and their color T.V. uses 350 watts per hour, how many kilowatt-hours do they use?
2. What would it cost the person in the above problem to watch T.V. per year if their electricity cost them 5 cents per kilowatt-hour?
3. Construct a bar graph for the watts used by the electrical appliance below:

Iron	1,100 watts
Refrigerator	240 watts
Vacuum cleaner	210 watts
Range	4,000 watts

Answers
1. 525 kWh, 2. $26.25

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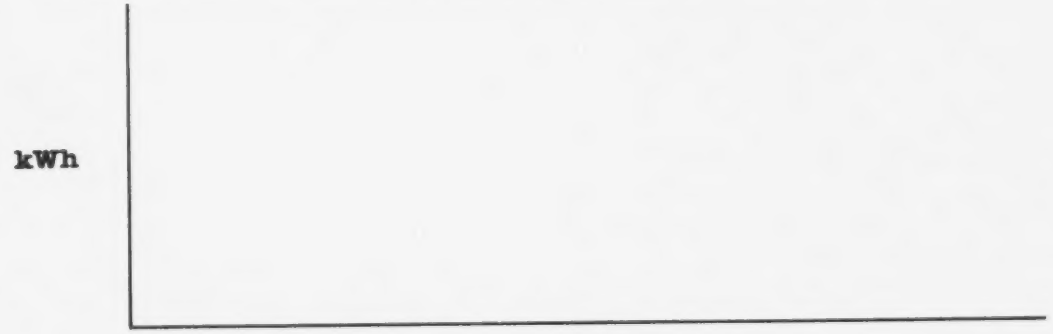
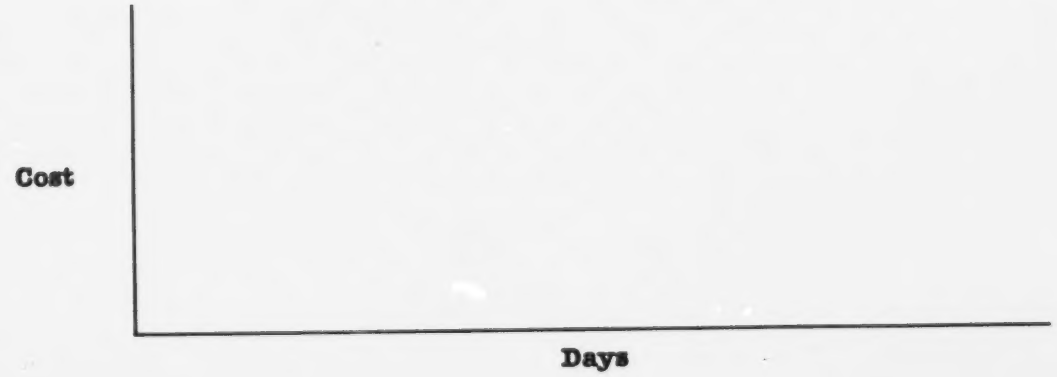
HOW MUCH TV DO YOU WATCH?

Name: _____ Date: _____

DAY	MON	TUE	WED	THUR	FRI	SAT	SUN	TOTAL
HOURS								
kWh								
COST								





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Activity No. 11

Music

Science, Language Arts, Art

conservation	grade	time
	4	2-30 min.

"Song Writers Step Forward"

Concept
There are various methods to conserve energy.

Objective
Given the opportunity to participate in a song writing contest, the student will write a song which focuses on energy conservation.

Materials
Award Certificate
Ribbons

Implementation

1. Announce to the class that a song writing contest is going to take place. Songs submitted should have an energy conservation theme. The songs should encourage conservation of our natural resources for us and for future generations.
2. Discuss contest rules:
   A. Contestants may write their own original tune with lyrics, or they might pick a familiar tune and write lyrics to go along with it.
   B. Entries should be proofread and neat.
   C. Students who wish to do so may submit a recorded version of their entry as well as a written one.
   D. The entire class will vote for a winner and two runners up.
3. Give each winner a ribbon. Make sure ALL entrants receive the certificate included with this lesson plan.
4. Have students design an 8½" x 11" album cover for their energy conservation song.

Optional Activity
Have the entire school participate. Each class will vote on one winning song to represent their class in the contest. Each song will then be recorded so that the entire school can listen to them and vote for a winner.

Suggested Assessment
Have students list four ways to conserve energy as identified in the classes' energy conservation songs.

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AWARD

This is to acknowledge the participation in & contribution to

Energy Conservation Song Writing

by

_____

who will practice & encourage others to do the same.

Instructor

Date

National Energy Foundation

Activity No. 12

Science
Mathematics

"It's Curtains For Conservation"

conservation

grade 4

time 5-30 min.

Concept
There are various methods to conserve energy.

Objective
Given the opportunity to participate in a classroom activity, students will recognize the effectiveness of curtains in conserving energy.

Materials
4 Thermometers

Implementation

1. Tape one thermometer to the inside of the classroom window. Tape a second thermometer to the outside of the curtains (room side). Place a third thermometer outside on the window ledge, and a fourth thermometer in the classroom.
2. During cold months, select a student to close the curtains at night. In the morning, have the students record the outside temperature, temperature inside the window and the temperature inside the room. Have the students find the difference in temperatures. Chart this information on the chalkboard.

   Repeat the procedure for 3 to 5 days. Have the students construct a line graph for each thermometer. Also, have them calculate an average temperature for each thermometer. Discuss the implications to energy conservation—the curtain as an insulator. Discuss with the students other ways to conserve energy.

   During warm months, close the curtains during the day and 30 to 60 minutes before the end of the day. Open the curtains and record the temperatures for the four thermometers. Repeat the procedure for 3 to 5 days. Have the students construct a line graph for each of the thermometers. Also have students calculate an average temperature for each thermometer. Discuss the implications to energy conservation. Discuss with students other ways to conserve energy.

Suggested Assessment

1. How can curtains be used to conserve energy in buildings?
2. List 4 ways which you could conserve energy at home or school.

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Activity No. 13

Language Arts
Science, Art

"Energy Haiku"

conservation

grade 4

time 30 min.

Concept
There are various methods to conserve energy.

Objective
Given a list of energy-related terms, the students will write Haiku poetry about using our energy resources in an efficient manner

Materials
Examples of Haiku from a language arts textbook
Word list
Paper
Pencil

Implementation

1. The pattern of a Haiku poem consists of three lines. The first has five syllables, the second line seven, and the third line five. Read several examples of Haiku to the class.

   Oil
   Deep within the earth.
   Increased usage daily now.
   Awareness... long life?

2. Discuss with the students the 5-7-5 form for a Haiku.
3. Tell the students you would like them to write a Haiku poem with an energy conservation theme.
4. Distribute the list of energy-related terms and discuss them with the class. The students may choose words from this list to include in their poem.
5. Write one poem as a class. Choose a word from the list. Write this as a title, then work through the lines, reminding the students of the 5-7-5 pattern.
6. Have students create a water color illustration of their Haiku poem.

Word List
Choose any of the following terms to use in the writing of your Haiku poetry.

alternate	reserves
coal	smog
conservation	volt
diesel	watt
electricity	impact
oil	limits
recycling	nuclear
solar	energy
water	natural gas
reusable	fume
uses	heat
sources	kilowatt
river	power
current	resources
environment	waste
fuel	usable
geothermal	awareness
hydroelectric	future
pollution	efficient

Optional Activity
As an art activity, have the students write their Haiku on rice paper. Encourage them to illustrate the poem around its edges.
Once all poems are written, why not sit on the floor in a circle, have some tea and Japanese cookies, and listen to each other reading Haiku.

Suggested Career Awareness Activity
Invite a poet to visit the class to discuss poetry and his/her occupation and style.

Suggested Assessment
Have students create an energy conservation Haiku poem.

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ENERGY

Multidisciplinary activities for the classroom developed by The National Energy Foundation especially for teachers.

5

TOP HIT ENERGY
LESSON PLANS
SIDE A
NATIONAL ENERGY FOUNDATION
1. Sources of Energy
2. Uses and Applications of Energy
3. Energy Conservation and Management
4. Environmental and Economic Impacts of Energy
5. Limits of Energy Resources and Supply
6. Energy Future
7. Energy Forms and Conversions
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SE 053 307

NATIONAL ENERGY FOUNDATION
Resources for Education

About the National Energy Foundation

The National Energy Foundation (NEF) is a unique nonprofit educational organization devoted to the development of instructional materials and teacher and student educational programs dealing with energy. NEF is supported by resources from business, government and education. NEF's primary concern is to present energy, science, technology and contemporary issues accurately and objectively.

To the Teacher

NEF instructional materials are teacher-developed, teacher-tested and multidisciplinary. The instructional materials are developed in accordance with NEF's **Conceptual Framework**. The seven goal areas of the **Conceptional Framework** are: Sources of Energy, Uses and Applications of Energy, Energy Forms and Conversions, Environmental and Economic Impacts of Energy, Limits of Energy Resources and Supply, Energy Future, and Energy Conservation and Management. Each goal area is then divided into concepts which are necessary to a fundamental understanding of energy. Listed under each concept are simply stated objectives.

About the Elementary Lesson Plans

The enclosed elementary lesson plans and activities have been selected as those most preferred by teachers and students. They have been designed for use within NEF implementation workshops. Included within each of the activities is a complete breakdown as to the time needed for implementation, materials required, implementation procedure, assessment questions, student handout masters (for duplication), identification of optional activities or career education suggestions and other information pertaining to the successful completion of the activity.

Warning: some of the activities are potentially hazardous due to the use of flammable substances and/or heat. Please exercise extreme caution. Check your local and state laws governing the use of flammable materials in the classroom. In addition, always be alert to possible electrical hazards. Each school year should begin with a review of the safe use of electricity, and each activity involving the use of electricity should be preceded by a reminder of safety procedures.

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NATIONAL ENERGY FOUNDATION
Resources for Education

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Activity No. 1

Science
Art

sources | grade | time

"Our Mr. Sun"

5

4-60 min.

Concept
The sun is the primary source of the earth's energy.

Objective
Given the opportunity, the student will learn that the sun is an energy source and is the original source of all energy.

Materials
Photosynthesis chart
Experiment for solar water heater
Materials are listed on enclosure.

Implementation

1. Show the film, "Our Mr. Sun, Parts I and II." Discuss the importance of the sun and the fact that all life on earth depends on the sun, and that it is our original source of energy.
2. Conduct the following activities to help students understand that the sun is the original source of all energy.

A. Have the students list the energy sources we use. Have the students research how the sun affects the formation or availability of these energy sources. This information could then be illustrated in a mural made by the class.

B. Conduct the solar heater experiment, as a class or in groups.

C. Discuss with students or have students do library research on today's technologies that use the sun's energy; passive and active solar systems, power towers, solar ponds, photovoltaics, etc.

Suggested Assessment
How could what you learned in the "Solar Heater Experiment" be applied to your home to provide energy?

Energy Source	Relationship to Sun
Fossil fuels (oil, natural gas, coal, etc.)	Fossil fuels are formed from decayed plants and animals. Plants get their food through photosynthesis (see the enclosed chart explaining photosynthesis). In turn, animals eat plants or other animals. Both plants and animals need the warmth of the sun.
Water power such as hydroelectric	We need rain in order to have a water supply. Without the sun, there would be no water cycle. The sun evaporates water from the earth, the water condenses, clouds are formed and precipitation in turn falls from the clouds.
Nuclear	The sun itself is a huge nuclear furnace, depending on fusion to produce its own heat and light energy.

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"SOLAR HEATER"

Name _____ Date _____

Materials needed

Two picture frames approximately 8" x 10" or smaller, with the glass included
Four pieces of black rubber tubing, each approximately 8" long and four pieces of light-colored rubber tubing
One piece black construction paper
Lamp, such as a study lamp, which is flexible, so that it can shine directly down on the table. The lamp should have a 100 watt bulb
A small water pitcher filled with water at about room temperature.
Thermometer
Scissors

Procedure

1. Cut the black construction paper to fit the picture frame.
2. Insert the construction paper on top of the glass in the picture frame.
3. Remove the cardboard back, but not the glass, in the second picture frame, invert the frame, and place it over the first frame, which is lying on the table, in order to form an air chamber between the frames.
4. Tie knots in one end of each of the rubber tubes.
5. Fill the tubes about 3/4 of the way with water from the pitcher and tie off the remaining ends so that the water is trapped inside.
6. Place a light and a dark colored, water-filled tube on the table next to the picture frame (solar heater).
7. Next, remove the top picture frame placing a light and dark colored, water-filled tube inside, on top of the construction paper, about 5" from the edge.
8. Then replace the top frame and place a light and a dark colored tube on top of the glass, but do not cover the tubes under the glass.
9. Finally, place a light and a dark colored water-filled tube a few feet away from the solar heater to serve as a control.
10. Place the study lamp over the rubber tubes and solar heater. Direct the lamp so that the rubber tubes and solar heater receive the same amount of light. The lamp should be about 10" above the table. Allow approximately 45 minutes.
11. After sufficient time, **starting** with the **control,** cut the end of the tubing off, insert the thermometer, and record the temperature of the water on the chart. Repeat the procedure with the tubes **outside** the heater, then the tubes **on** the heater, and finally, the tubes **inside** the heater.

Water Temperature

Tubing	Control	Outside the heater	On heater	In heater
Light				
Dark				

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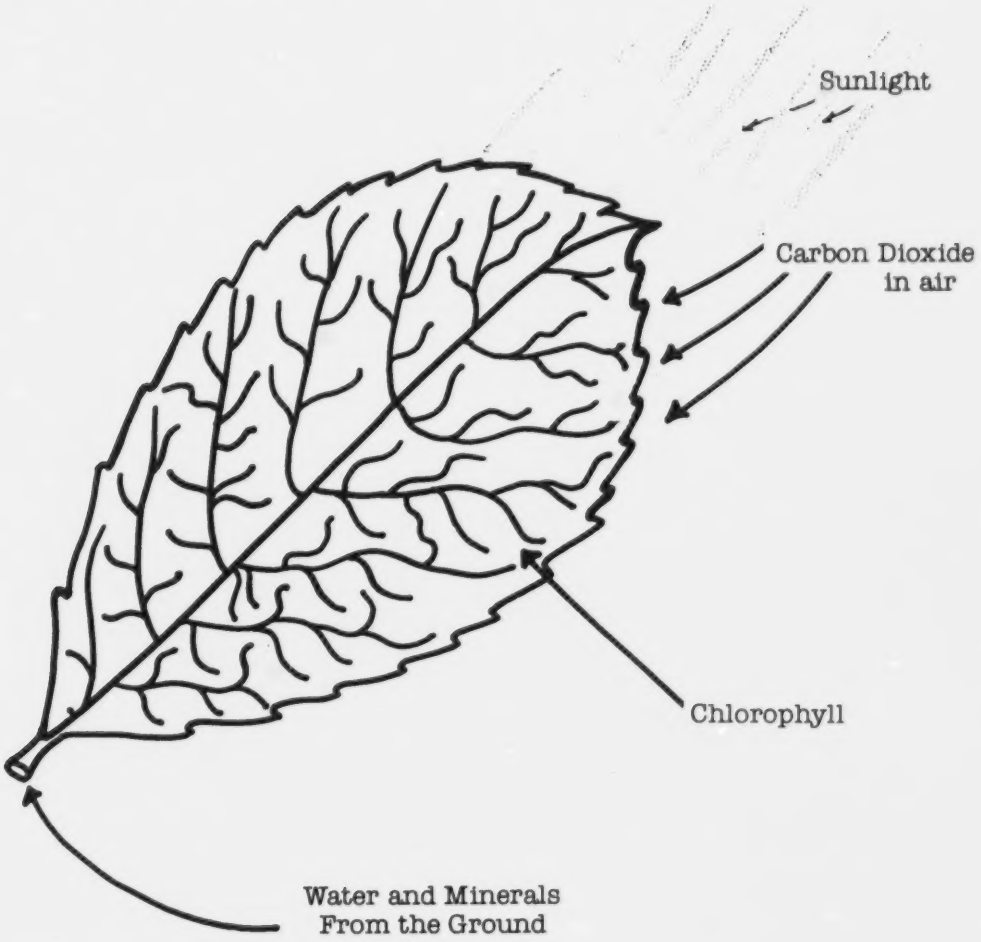
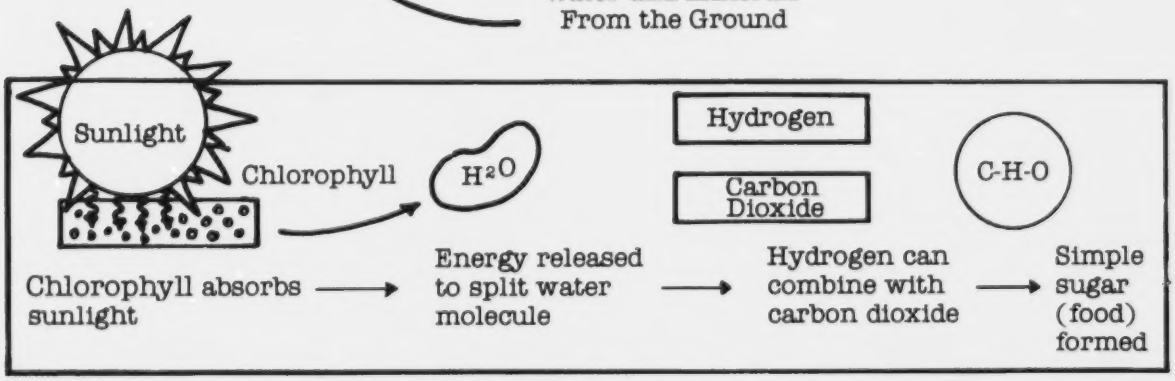
"PHOTOSYNTHESIS"

Name _____ Date _____

PHOTOSYNTHESIS

Photosynthesis is the means by which green plants manufacture food.





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Activity No. 2

Science
Language Arts

"Energy Source Lingo"

sources grade **5** time **30 min.**

Concept
Energy sources can be classified in many different ways.

Objective
The student will become familiar with the various energy sources as a result of playing a word game.

Materials
Word Definition Strips
Lingo grids
Corn, beads or any object to mark words

Implementation

1. Introduce the activity by indicating that the class is going to play a word game. Place the following Lingo vocabulary on the chalkboard:

   natural gas, crude oil, propane, methane, energy, BTU, hydrocarbon, coal, nuclear energy, solar energy, hydroelectric, electricity, gasoline, uranium, chemical energy, heat energy, wood, oil shale, refuse, wind, geothermal, fossil fuels, fuel, renewable energy, food, charcoal, synthetic fuel, lignite, tidal power, primary energy, fission, fusion.

2. Distribute the lingo grids (Student Handout) and instruct students to write one of the vocabulary words in each of the squares, leaving the middle space as a "free" space. Students may mix the words any way they wish. Explain that Lingo is played like Bingo.

3. Distribute corn, M&M's or other space markers.

4. Have the caller draw definition strips from a bag or box. Read the definition only. If the students can match the definition with a word on their list, then they should place a marker over that word. Continue until a student has a "Lingo," a complete lineup across or diagonally.

5. The student who has called "Lingo" must then correctly define all the words in his/her lingo. If he/she cannot correctly define the words the game continues.

6. After several plays, go over each word and definition with students. You may wish to repeat the game in one week to check retention.

Optional Activity
Have the students make crossword puzzles using these words.

Suggested Assessment
Have students define/describe the enclosed energy words.

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"WORD DEFINITION STRIPS"

Natural gas:
A combustible gas found in the earth used to heat homes, water, and cook food.

Crude oil:
Formed from animal and plant material at the bottom of ancient seas. Usually a black liquid.

Propane:
A combustible gas found in natural gas. It contains 3 carbon and 8 hydrogen atoms (C_3H_8).

Methane:
The most common combustible gas found in natural gas. It contains 1 carbon and 4 hydrogen atoms (CH_4).

Energy:
The ability to do work, derived from the conversion of an energy source.

BTU:
A measure of heat energy (British thermal unit).

Hydrocarbon:
A molecule made of hydrogen and carbon atoms: coal, oil, natural gas.

Coal:
A black combustible solid formed from plants. Often used to generate electricity.

Nuclear energy:
Energy produced by changes in the nucleus of atoms.

Solar energy:
Radiation energy from the sun. The primary source of all energy.

Hydroelectricity:
Electrical energy produced by a water-powered turbine generator located inside a dam.

Gasoline:
Produced from refined crude oil.

Uranium:
The fuel used in a nuclear reactor to generate electricity.

Chemical energy:
A form of energy contained in coal, natural gas, and oil.

Heat energy:
A form of energy produced from the combustion (burning) of coal, oil, natural gas; or the fission of uranium.

Wood:
Formed from the conversion of the sun's energy through photosynthesis.

Oil shale:
A sedimentary rock containing kerogen. The kerogen when heated yields crude oil.

Refuse:
Useless, unwanted, or discarded materials (garbage). Can be used to generate electricity, or produce natural gas.

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"WORD DEFINITION STRIPS"

Wind:
A form of kinetic (moving) energy produced in part by the sun's heating of the earth.

Geothermal:
Heat energy from within the earth.

Fossil fuels:
Formed from ancient plants and animals: coal, oil, natural gas.

Fuel:
Something that burns to produce heat energy.

Renewable energy:
A nondepletable source of energy, such as the sun.

Food:
Stored chemical energy produced by the conversion of solar energy through photosynthesis. A source of energy for animals.

Charcoal:
A carbon containing material produced by the heating of wood. Often used as a fuel.

Synthetic fuel:
Gaseous or liquid hydrocarbon fuel produced from a solid hydrocarbon fuel, such as coal.

Lignite:
A brownish, peat-like coal.

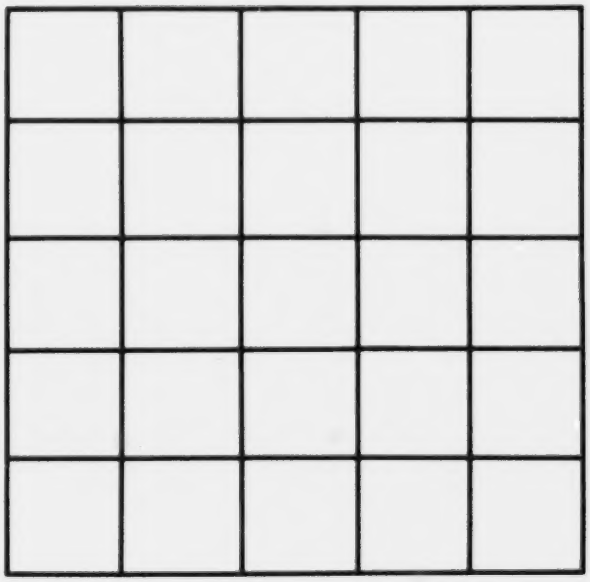
Tidal power:
Power obtained from falling and rising ocean tides.

Primary energy:
Energy in its naturally occurring form: coal, oil, natural gas.

Fission:
The splitting of atoms to release energy.

Fusion:
The combining of atoms to release energy.

Lingo



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Activity No. 3

Science

Social Studies, Language Arts

uses	grade	time
	5	5-45 min.

"The Past: You Are There!"

Concept
Every energy use decision affects standards of living and quality of life.

Objective
Given the opportunity, the student will role play, for a day, a person from a different era in the U.S. and research his/her era.

Implementation

1. Discuss how energy has changed the lifestyle in America as new inventions have appeared (a very general discussion, perhaps in 50-100 year intervals).
2. Discuss famous people who lived during the different times.
3. Have students decide which famous person they would like to become for a day. The teacher can regulate so each time period is represented.
4. One week of individual study follows. Each student will discover as much as possible about the person they are to become. What type of energy did that person use? What kind of life did he/she lead? Why are they famous? How did energy use influence their lifestyle?
5. The teacher may want to place books around the classroom for students to examine. Also charts of different styles of clothing, suggestions about cooking, bathing, travel, heat, etc., would be helpful.
6. On the assigned day, each student will come to school dressed as their famous person. The children will sit in chronological order with a sign stating their name and the year.
7. Each child will present a speech on his lifestyle and the energy he might have used in one day. Each speech will begin, "Hello, I am _____." In this way the presentation will be given in the first person.
8. The children may ask questions after each talk.
9. An overall discussion of the days' events may follow completion of the task.

Optional Activities

1. The teacher might want to dress and appear as someone else.
2. The teacher might want to prepare some games and activities from the past to break up the afternoon.

Suggested Career Awareness Activity
As part of the research, the student could find out about the childhood interests of the person being studied and compare those personal interests with those of him/herself.

Suggested Assessment
Compare and contrast the lifestyle and energy-use of a time in the past to yours today.

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Activity No. 4

Social Studies
Science

uses	grade	time
	5	4-30 min.

"Energy—How Do We Use It"

Concept
Each form of energy can be used in many ways.

Objective
Given the opportunity, the student will be able to list ways we use energy in the home and community and then list conservation measures for those uses.

Materials
Film: "Transportation Revolution: Story of America's Growth," LCA, 1970

Implementation

1. Have the students in a class discussion fill in a chart like the example.
2. Discuss with students the following:
   A. Ask the students which of the listed items they use. Why?
   B. How often do you use them?
   C. From the list, which items are used the most? The least? Why?
   D. If you had to, could you cut down on the use of some of the items? Which ones? How would you do it?
   E. What are some things people could do to cut down on using so much energy? Make a class list of solutions.
   F. Why do you suppose people use so much energy?
   G. What would happen if we could not use various items anymore? What would people do?
   H. What source(s) of energy are used in each of the above?
3. Invite a person to class to talk about the energy use and life-styles in the 1920s and 1930s. Using the categories listed on the chart, have the students compare the past with the present. List advantages and disadvantages. Were people happy then? Did they have fun with what they had as compared to today? (Discuss the notion that possibly we shouldn't equate happiness with material conveniences.)
4. Show film, "Transportation Revolution." Discuss and relate to present and past energy uses.

Suggested Career Awareness Activity
Discuss the jobs associated with each use of energy. Invite a person from the natural gas company or the electric utility to discuss jobs involved in their industry to deliver energy for our use.

Suggested Assessment
List four uses of energy in the home and school, and ways in which each could be conserved.

USES OF ENERGY IN:

Home	School	Transportation	Industry	Services	Recreation
1. Heater	*Lights*	*Car*	*Lights*		
2. Stove	*Heat*	*Truck*	*Machines*		
3. Lights		*Bike*			
4.		*Walking*			
5.					

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Activity No. 5

Mathematics
Science

conversions	grade	time
	5	2-45 min.

"Water To Electricity"

Concept
There are human made and natural energy conversion systems.

Objective
Given the opportunity, the student will compute the amount of water (in liters) required to operate various electrical appliances for given periods of time.

Materials
"Water To Electricity"
"How to Read Your Meter"
"Reading Your Electric Meter"

Implementation

1. Inform students that electricity (electrical energy) is a form of energy produced from the conversion of an energy source: coal, oil, natural gas, uranium (nuclear), or water (hydro-electric).

   A. Explain how fossil fuels (coal, oil, natural gas) and uranium are converted to generate electricity.

      1. Fossil fuels. Coal, oil and natural gas are burned to produce heat energy. The heat energy is used to turn water into steam. The steam, under pressure, is used to turn a turbine. The spinning turbine causes the magnets in the generator to spin, inducing an electric current.

      2. Nuclear. The process is similar in nuclear reactors, except uranium atoms fission (split) producing the heat energy used to turn water into steam.

   B. Explain how water is used to generate electricity.

      1. Provide students with a copy of the Hydroelectric Dam or make an overhead transparency.

      2. Discuss that hydroelectric dams are built to control the flow of water and to increase the water pressure. Water pressure is related to the depth of the reservoir. The greater the water pressure the greater the power. Water flows through the dam in pipes, called penstocks. The water is applied to a turbine, which spins a generator producing electricity.

2. Inform students that it requires approximately 16 liters of water falling 30 meters to produce one watt-hour of electrical energy, or about 16,000 liters to produce one kilowatt-hour of electricity.

3. Pass out the student worksheet "Water To Electricity" and have students complete the questions. You may wish to make this a homework assignment.

4. In order to complete this part of the activity, the student must learn how to read an electric meter. Pass out copies of "How to Read Your Electric Meter" and go over it until all students understand how to read their electric meter.

5. Provide students with a copy of "Reading Your Electric Meter," and have them complete the activity.

Optional Activity
The students might try another week of reading the meter, this time after the family has discussed ways of conserving electricity at home. Compare the amount of electricity used during that week with the amount used the prior week. Compare the equivalent number of liters of water.

Suggested Career Awareness Activity
Invite a local utility worker to class to explain his/her job and how water is converted to electricity.

Suggested Assessment

1. Explain how water is converted to electricity in hydroelectric dams.

2. Explain how water is used to generate electricity in coal, natural gas, or oil fired power plants.

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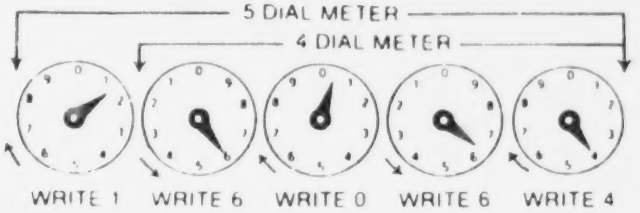
"HOW TO READ YOUR ELECTRIC METER"

Name _____ Date _____

The dials are like watch faces lined in a row (every other dial moves counterclockwise). The reading for a five dial meter would be 16,064. The reading for a four dial meter would be 6,064.



Notice that when the pointer is between two numbers, you should record the lower of the two numbers.

When the pointer seems to be directly on a number, look at the dial to the right; if the pointer on the right side of the dial has passed "0", then write down the number the pointer seems to be on; if the pointer on the right side dial has not passed "0", then write down the previous lower number on the dial you are recording.

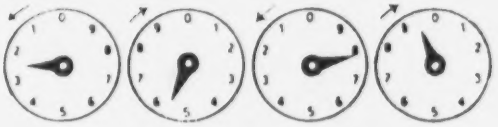
Record the Readings for the Following Meters

METER NO. 1

A _____

B _____

METER NO. 2



A _____

B _____

Subtract the number of line A from the number on line B to find the number of kWh of electricity used.

Line B _____

Line A _____

kWh _____

Line B _____

Line A _____

kWh _____

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Activity No. 5

"Water To Electricity"

"READING YOUR ELECTRIC METER"

Name _____ Date _____

Record the reading on your electric meter for each day. Be sure to read your electric meter at the same time each day.

DAY 1

Meter Reading Day 1 _____

DAY 2

Reading Day 2 _____
Reading Day 1 _____
Energy used _____

DAY 3

Reading Day 3 _____
Reading Day 2 _____
Energy used _____

DAY 4

Reading Day 4 _____
Reading Day 3 _____
Energy used _____

DAY 5

Reading Day 5 _____
Reading Day 4 _____
Energy used _____

DAY 6

Reading Day 6 _____
Reading Day 5 _____
Energy used _____

DAY 7

Reading Day 7 _____
Reading Day 6 _____
Energy used _____

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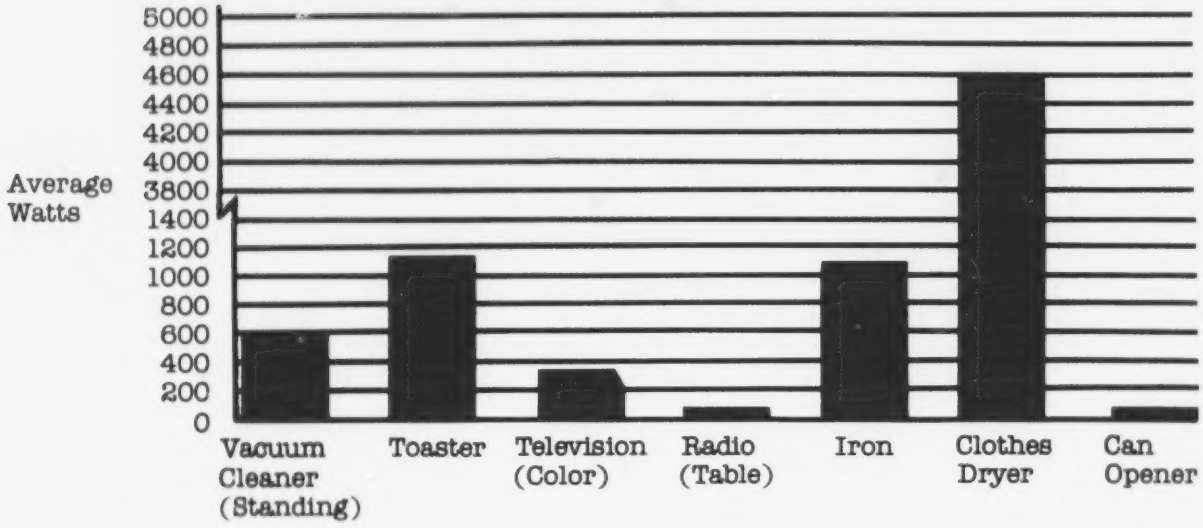
"WATER TO ELECTRICITY"

Name _____ Date _____

1. Study the bar graph below and answer the following questions.
   A. Which appliance shown on the graph requires the greatest amount of electricity for its operation?
   B. Which appliance requires the least amount of electricity?
   C. Which appliance is used most often in your home?
   D. Which appliance do you consider to be most important to your family?
   E. Which appliance do you think your family could do without?
   F. How many watts of electrical energy are required to operate the electric can opener? How many liters of water would have to pass over a 30 meter high dam to operate the can opener for one hour?
   G. How many watts of electrical energy are required to operate the clothes dryer? How many liters of water must pass over the dam to operate the dryer for one hour? For three hours?
   H. Compute the equivalent number of liters of water required to operate each of the other appliances for one hour.
   I. Assume that all of the appliances shown on the graph were being used in your house at the same time. How many liters of water would be required to produce electricity to operate the appliances for one hour?
2. Explain how water is used to generate electricity in a hydroelectric dam.
3. How is water used in a coal, oil or natural gas power plant to generate electricity?
4. What determines how much power is available to generate electricity from hydroelectric dams?

Average Wattage of Various Home Electrical Appliances



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Activity No. 6

Science
Mathematics, Art, Language Arts

"Solar Collectors"

conversions	grade	time
	5	3-45 min.

Concept
The efficiency of energy conversion systems differ.

Objective
Given the opportunity, the student will be able to explain that solar collectors of different colors and absorption mediums will convert solar energy to heat energy at different efficiencies.

Materials
Various colors of paint
Coffee cans
Thermometers—one for each coffee can
Plastic wrap
Tape
Dirt, sand, gravel, styrofoam, saltwater to fill coffee cans.

Implementation

1. In small groups have students select a color (black should be one of the colors) from those available and paint a coffee can. The coffee cans should be of the same size.
2. Fill each coffee can half full of water and cover with plastic wrap. Use tape to hold plastic wrap in place. Insert a thermometer to measure the temperature of the water. Place cans in the sunlight for several hours. Measure water temperature at 30 minute intervals and the first thing the next morning.
3. Students will then prepare graphs to plot temperature against time, at 30 minute intervals.
4. Repeat the above using different heat storage mediums: dirt, gravel, sand, salt water, styrofoam. Use unpainted coffee cans.
5. Discuss with students the results of the investigations. Ask:
   A. Which color(s) absorbed the most heat energy? Why?
   B. Which storage medium absorbed the most heat energy? Why?
   C. Which color and storage medium retained its heat energy the best?
   D. Which system is the most efficient?
   E. What combination of color and storage medium would you think absorbs and retains the most heat?
   F. How might you use what you have learned in the investigations to obtain energy for use in your home.
6. Divide students into groups to research one of the following solar energy technologies and prepare an oral report. They should include drawings, describe how the technology works, its feasibility, how the sun is used and other advantages and disadvantages.

   solar ponds
   power towers
   ocean thermal energy conversion systems
   photovoltaics
   passive solar technologies
   active solar technologies
   wind energy
   tidal energy

Suggested Career Awareness Activity
Invite a speaker who works in the area of solar energy to speak to the class about his/her job.

Suggested Assessment
Explain how you would apply what you learned from the investigations to heat water for your home.

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Activity No. 7

Science
Social Studies

impacts | grade | time

"The Air Yells, 'Help!'"

5 | 5-60 min.

Concept
Energy resource development and use alter environmental conditions.

Objective
Given the opportunity, the student will trace the development of transportation in the U.S. from its earliest forms to present day, and list environmental impacts of modern transportation.

Materials
Films: "The Development of Transportation in the U.S.," ENBE, 1958
"Autos and All That Traffic," COLB, 1969, McGraw-Hill
Tagboard
Petroleum jelly

Implementation

1. Show movie, "The Development of Transportation in the U.S."
2. Divide class into groups. Have each research the development of transportation for their time period: 1700-1750, 1750-1800, 1800-1850, 1850-1900, 1900-1950, 1950-present.
3. As a class, make a time-line of important developments in U.S. transportation.
4. Have students discuss and list what impact modern forms of transportation have had on the environment. Consider noise and air pollution; space for railroads, freeways; energy consumption, etc.
5. Have students prepare six 7cm x 10cm tagboard pieces heavily coated with petroleum jelly. Go to the school parking lot. Choose large, small, old and new models of cars.
6. Include one without a pollution device, if possible. Having obtained the permission of the car owner, the TEACHER should start the car's engine. Select a responsible student to collect exhaust emissions on the tagboard by holding the cards directly behind the exhaust pipe. *(WARNING: Do not allow students to breathe exhaust fumes or touch the exhaust pipes. This experiment MUST be done under STRICT SUPERVISION.)* Record the year and make of the car on the cardboard. Be sure to run each engine for the same length of time. Compare the tagboards and discuss the findings. Record class findings on a chart.
7. Divide class into groups. At a different time each day, each group will inventory traffic at a location near the school, recording its findings on a classroom chart similar to the one below.
8. After all groups have reported, class can tally the last three columns and figure the percentage of vehicles which are polluting the air or noise level.
9. Show movie, "Autos and All That Traffic."
10. Have the student keep a journal of his/her family's use of the auto for one week. Record dates, miles driven, reason, number of passengers, etc.

continued next page

TRAFFIC INVENTOR

Date	Time	No. of Vehicles	Vehicles Emitting Exhaust	Vehicles	Noisy Passenger

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Activity No. 7

11. The student will examine his/her record for the following considerations. When would it have been practical, considering environmental impacts as well as convenience, to:

    A. Walk.
    B. Ride a bike.
    C. Car pool.
    D. Use mass transit.
    E. Other.

12. The student will formulate a plan of action to reduce environmental impact and conserve energy from his/her records. Have the family implement this plan for one week.

13. The student will describe changes in his/her family's daily activities which would result if they had no auto.

14. As a class, discuss changes made in transportation use and lifestyle effects. Discuss personal advantages and disadvantages.

Optional Activities

1. The student will pretend he/she is to write a law restricting the use of personal autos to reduce air, noise and space pollution and energy consumption.

2. The student will find out what people in the community think should be done to control auto pollution. Make findings known to legislators.

Suggested Career Awareness Activity

Invite a member of the city council to visit the class to be interviewed about his/her job in relation to auto pollution.

Suggested Assessment

List three things to help reduce auto pollution and conserve energy.

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Activity No. 8

Science

limits	grade	time
	5	2-45 min.

"What is a Natural System?"

Concept
All energy sources have limits to their usefulness.

Objective
Given the opportunity, the student will demonstrate the knowledge that natural systems directly affect and limit energy sources.

Materials
Three one-gallon jars
Plastic wrap to cover the jars
Rubber bands
Gravel
Charcoal
Sand
Plants

Implementation

1. For discussion, ask the question, "What is a *natural* system?" Students should arrive at the conclusion that a natural system is not artificially made, but is a cycle or system in nature, e.g., watercycle, carbon cycle, oxygen-carbon dioxide cycle, etc. Discuss the fact that energy is not cycled but converted from one form to another.

2. Have the students work in groups to research and give oral reports, using pictures and diagrams, on the following:
   A. The oxygen-carbon dioxide cycle.
   B. The carbon cycle
   C. The water cycle
   D. A food chain
   E. Energy formation (coal, oil, natural gas).

3. Have the students use three one-gallon glass jars in order to make three terrariums. (Often these jars may be obtained from the school cafeteria.) Have the students perform the following in order to see the effect natural systems have upon the energy in an ecosystem:
   A. Place gravel and charcoal in the bottom of the gallon jars. (A briquette or fireplace charcoal may be used.)
   B. Mix soil and sand and place in the three jars. (Obtain sand from a river, if possible, as it will contain more humus material.)
   C. Obtain plants to place in two of the terrariums.
   D. Water the three terrariums adequately and place clear plastic wrap over the tops. Hold the plastic wrap in place with a rubber band.
   E. Place one of the terrariums containing plants where it will receive adequate sunshine but not so much heat that it will dry out.
   F. Place the other terrarium containing plants in the dark.
   G. Place the third terrarium, in which the students did not place any plants, in a sunny position, similar to terrarium number one.

4. Have the students observe and record data on the three terrariums. What happens to the water cycle in the three terrariums? Is the sun's energy a necessary part of the water cycle? Why? Do plants grow in the third terrarium even though none were planted? Why? In most cases plants will grow because the soil is not sterile.

5. Follow up: Have the students respond orally or in writing to the following questions.
   A. What effect does lack of rain or change in our water cycle have on our energy supply?
   B. What happens to the plants in the terrarium in the dark?
   C. How does the sun's energy limit plant growth and the formation of coal, oil or natural gas?

Suggested Career Awareness Activity
Invite a meteorologist or greenhouse keeper to class to tell about his/her job and to explain the water cycle in relationship to the earth.

Suggested Assessment
Have students describe how natural systems directly affect and limit energy sources.

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Activity No. 9

Language Arts
Social Studies, Science, Art

"A Happy Ending"

limits grade **5** time **2-45 min.**

Concept
All energy resources have limits to their usefulness.

Objective
Given the opportunity, the student will be able to understand what a nonrenewable resource is, and their limits.

Materials
The play: "A Happy Ending"

Implementation
1. Have a group of students perform the play "A Happy Ending."
2. Discuss the following after students have performed the play:
   A. What is a nonrenewable resource? Renewable resource?
   B. How are resources limited in their usefulness?
   C. How might the depletion of resources affect ones life-style, environment?
3. Have students create an illustration of one of the dialogues and share it with the class.

Suggested Career Awareness Activity
Invite an adult involved with drama to talk about acting. He/she might demonstrate a few techniques on how to verbally deliver a script to an audience.

Suggested Assessment
1. Why is coal, oil, and natural gas referred to as nonrenewable?
2. How are energy sources limited in their usefulness?

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"A HAPPY ENDING"

Name _____ Date _____

This play can be produced on a stage or as a radio program. It can be taped and played back to the class as another learning experience.

CHARACTERS
Aluminum
Coal
Copper
Iron
Natural Gas
Crude Oil
Concerned Citizen
Unconcerned Citizen
Announcer

ANNOUNCER:
This is a make-believe story about the world's nonrenewable resources; that is, resources that cannot be replaced once they are used up. It could never happen in real life because nonrenewable resources cannot talk, but we think if they could this would be what they would say to us.

Our story opens up in a museum where aluminum, coal, copper, iron, natural gas and crude oil are on display in a case labeled "nonrenewable resources."

COAL:
Do you guys realize that I'm only going to be around for another century or two and then I'll be all used up... I'll be all gone... depleted, if people don't change their ways!!

ALUMINUM:
Depleted! What in the world does depleted mean?

COPPER:
That means used up and destroyed forever. I might be depleted too. That makes me very sad because I have done so much for people since I was discovered. Why, I am even put in money now because our friend silver is almost all gone.

IRON:
Yes, I might be depleted sooner or later too.

NATURAL GAS:
And I might be depleted someday too.

CRUDE OIL:
I've only got decades to go too, if people aren't careful.

COAL:
Wow, I never thought I'd see the day when our jobs might finally be over. And do you realize that none of us can be produced by people?

CRUDE OIL:
Yes, and it took millions of years to make us and we might be gone before you know it. I just wonder what people plan to do if we are all used up?

NATURAL GAS:
Yes, so do I! I don't think people have even begun to realize what we do for them and what will happen if we are gone. Why, I help heat homes, cook food, help to run factories, dry clothes, heat water, and many more things.

COAL:
Yes, I also heat and run homes, factories, schools, hospitals, office buildings and many more things. I'm also used to supply big power plants with energy so that they can produce electric power for many homes, towns, and big cities. I'd like to see people use me wisely.

CRUDE OIL:
How about me? Without crude oil, people couldn't run cars, buses, trains, planes, motorcycles, and any other thing with an engine in it. I also make cosmetics, paints, fertilizers, and many synthetic materials.

IRON:
Without me people couldn't build sky-scrapers and bridges, hospitals, schools

continued

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and churches. I just wonder if people know exactly what they are headed for?

COAL:
I don't know, but here come two of them now. Why don't we ask them?

CONCERNED CITIZEN:
(Walking toward the display of nonrenewable resources.) Boy, is this ever a nice museum! I really had no idea they could put so much material into a museum. Isn't it just great?

UNCONCERNED CITIZEN:
Yeah, I guess so if you dig this sort of thing. Me, I'd rather be at the beach enjoying the sun and surf. Of course, with the gas shortage and all I can't drive to the beach, so I guess I'll have to settle for second best. That's life!

CONCERNED CITIZEN:
Yes, that's life, but I just wonder if there isn't something we can do about it. You know for years we have used all our natural resources without thinking that maybe someday they would be used up. I hope maybe it isn't too late to start doing something about it. I already am trying to conserve by turning my thermostat down, by riding my bike instead of driving my car, and driving 55 mph on the highway. But I'm sure there must be many more things I can do.

UNCONCERNED CITIZEN:
Yeah, I suppose so but I figure there are enough other people conserving that if I don't it won't matter.

CONCERNED CITIZEN:
Hey, look over there! There's a display of nonrenewable resources. Those are resources that can never be replaced. This ought to be interesting. Come on; let's go! (They walk over to the display and look down on it.)

COAL:
Hello there. (The two citizens look around shocked, then focus their attention on the piece of coal.)

CONCERNED CITIZEN:
Hey, did you hear that piece of coal say something?

COAL:
Of course I said something. Isn't it about time we nonrenewable resources said something to the objects that are using us?

CONCERNED CITIZEN:
Yes, I suppose so, but I just never thought I'd hear a piece of coal talking to me. I've used you for years to heat my home, but I certainly never carried on a conversation with you before!

COAL:
That's the whole point! You've used us for years, but you never stopped to think and understand what is happening to us. Do you realize that all of us in this display case might be completely used up? Gone?

UNCONCERNED CITIZEN:
Big deal! So what? Scientists have saved us before, so why can't they do it again? We don't need you, because I'm sure we'll find something else to take your place.

CRUDE OIL:
This could very well be, but I wouldn't count on it. Scientists are now working on all sorts of forms of energy such as geothermal, solar and nuclear energy, but they all have problems that have to be worked out. Besides, what you and so many other people don't realize is that all of us are used in a lot more ways than you can even imagine. Did you know that I'm used to make all of those beautiful synthetic fabrics we have today and that without me our factories couldn't run to produce those materials?

ALUMINUM:
Yes, and did you know that I am found in such things as doors, toys, car parts, boats, bicycles, rocket fuel, street signs, knitting needles, jewelry, Christmas tree tinsel, mobile homes, and many many more things you haven't even thought about? Can you imagine how hard it would be to even start to find a replacement for all these things?

continued

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IRON:
Yes, and do you realize how many jobs our industries provide for people? Why, we provide jobs for miners, architects, geologists, metallurgists, market analysists, bookkeepers, data processors, secretaries, personnel managers, advertising specialists, and many many more.

COPPER:
Hey, how about me? I carry electricity from generating plants to all our homes, schools and businesses. I just wonder what will happen to people if all of us are used up. Do you have any ideas at all about what is going to happen?

UNCONCERNED CITIZEN:
I never really thought about it before, but I just always thought that science would invent anything we needed. I never thought that maybe we would run out of the things we need to invent new things! That's really something to think about.

CONCERNED CITIZEN:
You're right, and it's about time we started thinking about it and doing something about it. (Turning to the display of nonrenewable resource.) Do you guys have any suggestions?

ALUMINUM:
Yes, I have one. Instead of throwing away things that are made out of me, such as used cans, old toys, aluminum doors, and many more things, save them and recycle them. You know some cities have places where you can sell me back again to be used over and over.

COAL:
You can make me last longer by being very careful about using electricity. Don't run electrical appliances when it isn't necessary, turn out lights when you leave a room, turn down your thermostat, keep your house well insulated so heat won't escape and never use electrical power unless it is really necessary. I'm sure you can think of many more things if you really think about it.

COPPER:
I can also be recycled or used again just as aluminum can. I really wonder how much of me can be found in old junkyards and garbage dumps?

IRON:
I too can be recycled and made into brand new things like car parts and parts for almost all kinds of machines and equipment.

NATURAL GAS:
I can be conserved in the same way coal is; by taking it easy and being very, very careful with the things I help run. For instance, people can save natural gas by always running a full load of clothes in a gas washer and hanging their wash outside when possible instead of running their gas dryer. Also, you can save natural gas by always making sure your gas appliances are in perfect running order.

CRUDE OIL:
I guess most people think of me when they think of cars, but I also do many more jobs. They make liquid gasoline, oil, and kerosene out of me. I help all kinds of machines work, I oil hinges in doors, and I run cars. If people drove 55 mph, only drove their cars when it was necessary, and rode in car pools to work, it would really help conserve me. I think we would all agree that we must all do all we can to help, because when everyone works together things always seem to work out for the best.

CONCERNED CITIZEN:
Yes, I agree completely, don't you? (Talking to his friend.)

UNCONCERNED CITIZEN:
Well, I know one thing; I'm going to do all I can to help because I sure don't want to lose all our friends here. I wish I had started sooner, but maybe it's not too late.

CONCERNED CITIZEN:
Yes, maybe it's not too late after all. If we all work together we still can have a good world to live in.

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Activity No. 10

Science

Social Studies, Art, Language Arts

"Will It Change Our Lifestyle?"

future	grade	time
?	5	2-45 min.

Concept
Energy availability will affect future lifestyles and cultural conditions.

Objective
Given the opportunity, the student will be able to determine that lifestyles in the future may differ from the present because of changes in energy availability and new developments in the field of energy.

Implementation

1. Discuss with students the subject of future energy sources and uses and the effects of such on our lifestyles. Ask students to name some of the energy sources being presently considered for development as "future" sources. List their responses on the chalkboard. Possible responses might be: solar, tidal or wind energy.
2. Discuss with students some of our current energy sources and uses. List their responses on the chalkboard.
3. Ask each student to choose a "future" energy source listed on the chalkboard. Have the students list their choice and on a sheet of paper, list the various effects the use of their particular energy source would have upon our lifestyles. Now have students select a current energy source and list the various effects running out of the energy source would have on their lifestyles. Have students consider things such as architecture, land use, jobs, recreation, transportation, and other activities associated with their current lifestyle. Have the students share their lists.
4. Have each student use the energy sources chosen in step 3 and develop a story and illustrations for each. The title for their future energy source selection is: "My Community Runs on _____ (student's choice) Power." The title for their current energy source selections is: "My Community Runs Out of _____ (student's choice) Power." Have students include as many examples as possible demonstrating the effects of their particular power source upon architecture, land use, jobs, recreation, transportation, etc.
5. Place the completed stories on display in the room.

Suggested Assessment
List one "future" energy source and one current energy source and explain how their use (future energy source) or depletion (current energy source) may affect your current lifestyle.

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Activity No. 11

Science
Social Studies, Language Arts

"New Energy Technology"

future	grade	time
?	5	5-45 min.

Concept
Energy availability will affect future lifestyles and cultural conditions.

Objective
Given the opportunity, the student will write a description of a technology that is helping an old energy source become more efficient or a technology that is developing new sources of energy.

Implementation
1. List the following subject areas on the chalkboard and have students choose which area they would like to research:
   A. New energy technologies and their impact on current energy source (coal, oil, natural gas) use.
   B. New energy resources and how they would be used.
2. Have students emphasize: the changes, if any, on their current lifestyle, technology, and use.
3. After sufficient study time has elapsed, have the students discuss their findings.

Suggested Career Awareness Activity
Have students describe the jobs created through the use of energy sources.

Suggested Assessment
Describe how energy use may affect future lifestyles.

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Activity No. 12

Science
Mathematics, Social Studies

"Controlling The Rate of Consumption"

conservation | grade 5 | time 45 min.

Concept
The implementation of energy conservation practices is affected by social and political decisions.

Objective
Students will be able to analyze the effects of conservation as compared to unlimited consumption, on the life expectancy of energy resources.

Materials
Two cookies per child
Clock or timing device
Napkins

Implementation

1. Give each student a cookie and napkin.
2. When the signal is given have students begin eating their cookie. Have them stand when they have finished eating their cookie. Count the students that have finished their cookie every 15 seconds until all cookies are consumed. Once a student stands, he/she must keep standing until all students are finished.
3. Create a line graph for the data, students standing versus time. You may wish to have students create the graph.
4. Distribute a second cookie. This time students can only take a bit when you say "take a bite" (every 15 seconds). The system is the same—students stand when finished and you tally the standing students every 15 seconds.
5. Again construct a line graph.
6. Compare the graphs: Graph One represents unlimited consumption while Graph Two represents conservation. Is Graph Two like Graph One? How are they different? How long did it take for all resources to be eliminated?
7. Discuss the term "conservation." In the second exercise, conservation was practiced. Does conservation result in preservation? Why not? What good does it do to conserve? What happens to the life expectancy of the energy resource under conservation?
8. Divergent Questioning Techniques:
   A. How was the rate of consumption controlled in the second cookie?
   B. Can we control how rapidly we use resources?
   C. Does this have any implications for the use of coal, natural gas, oil, electricity? If so, what?
9. Discuss with students why and how people conserve energy. Use the following as examples: 55 mph speed limit, thermostats lowered to 68° F, daylight savings time, taxes (gasoline tax), etc. This option can be expanded and enhanced by having students research the social, political and economic aspects of energy conservation.

Suggested Assessment
True or False:

1. Energy conservation increases the total amount of energy available.
2. Conservation can be a form of regulation.
3. Economics (cost of goods/services) causes individuals to reduce their use... conserve.
4. Conservation increases the life expectancy of the energy resource.

Answers
1-F, 2-T, 3-T, 4-T

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Activity No. 13

Drama
Language Arts, Art

conservation | grade | time

"It's Mime Time"

5

2-30 min.

Concept
Energy conservation practices affect lifestyles, quality of life and standard of living.

Objective
Given an opportunity to create a pantomime, the student will demonstrate that conservation may modify lifestyles.

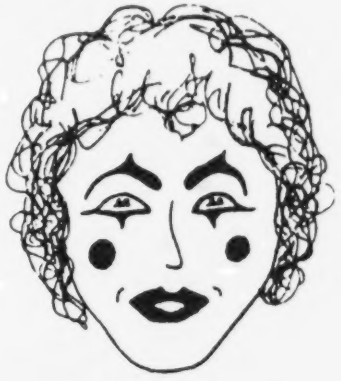
Materials
Stimulus cards
White pancake makeup (available at costume shops or from your high school drama department)
Black eye liner or greasepaint
Red rouge or lipstick
Small paintbrush
Cold cream
Tissue

Implementation

1. Begin this activity by dividing the class into two teams. Have a member from each team come up to get one stimulus card. There are two types of stimulus cards. One type depicts situations "before" conservation practices are put to work; the other type depicts situations "after" conservation practices are in effect. (See Sample cards attached.)
2. Allow each team representative time to read and react to the stimulus card drawn.
3. One at a time, each team member will create and present a pantomime illustrating the situation on the stimulus card.
4. Each team will observe their team member's mime carefully and then decide whether or not the mime was a "before" or "after" energy conservation situation. When agreement has been reached, one team member will report the decision to the teacher. If they are right, the team wins one point. The team with the most points at the end of a pre-determined period wins. (Suggested duration of contest: 15 minutes)
5. At the conclusion of the activity, discuss each stimulus card with students.
6. Have students create their own "before" or "after" situation stimulus cards, and repeat the activity.

Optional Activity
To enhance the activity, teach the students how to apply authentic mime makeup. Recipe for this is as follows:

Recipe for a Mime Face



Procedure:

A. Cream the face with cold cream. Cream off.
B. Next, apply white pancake to the entire face and neck area. Be sure to apply right over the eyebrows.
C. Then draw a line along the eyelid with the black eye liner. Extend this line 2 cm beyond the corner of the eye.
D. Using the black eye liner or greasepaint, draw a single line above and below the middle of the eye, and perpendicular to the eye.
E. Use a paint brush to paint the lips with the black eye liner or greasepaint.
F. Apply rouge in a circle on the cheeks.
G. Draw an arch over the eyebrow with the black eye liner or greasepaint.

NOTE: If you are not able to locate white pancake or greasepaint, make a substitution by using a white under-eye makeup stick. This can be obtained from most cosmetic counters.

Suggested Assessment
List four ways to conserve energy.

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"PANTOMIME STIMULUS CARDS"

Name _____ Date _____

"BEFORE" CONSERVATION PRACTICES

TYPE OF SITUATION: BEFORE
You just arrive home from school. Turn on the lights as you move from room to room in the house. Spend lots of time gazing into the refrigerator deciding on a snack. Then, watch T.V.

TYPE OF SITUATION: BEFORE
You are getting ready for bed. Go into the bathroom to brush your teeth. You run the water the entire time that you are gazing around the room and brushing your teeth.

TYPE OF SITUATION: BEFORE
You are busily preparing breakfast. Use many appliances to aid you. Put the orange juice in the blender. Whip the eggs with an electric beater. Use an electric knife to slice the toast!

TYPE OF SITUATION: BEFORE
You are watching television. Suddenly you notice that you are very cold. Run to the thermostat and turn it up! That's not enough for you. Get a portable heater and plug that in too.

TYPE OF SITUATION: BEFORE
You are driving to work. It's very quiet in the car. There's no one to talk to. You are very bored and sleepy. Friends wave to you as they pass you in their lonely cars!

TYPE OF SITUATION: BEFORE
It's dinner time and you are setting the table. Place one paper napkin for each person by their plate. Leave the rest of the stack on the table too. By the end of the meal, you have used at least 10 napkins for various needs.

"AFTER" CONSERVATION PRACTICES

TYPE OF SITUATION: AFTER
You just arrived home from school. As you move from room to room in the house, don't turn on any lights! Decide what you want for a snack and then open the refrigerator. Then, sit and read.

TYPE OF SITUATION: AFTER
You are getting ready for bed. Go into the bathroom to brush your teeth. Moisten your toothbrush and then immediately turn off the water. Turn it on again when you need to rinse.

TYPE OF SITUATION: AFTER
You are busily preparing breakfast. Try not to use electric appliances as you work. Make fresh orange juice with a "hand squeezer." Beat up the eggs with a wire whip, etc.

TYPE OF SITUATION: AFTER
You are quietly reading. Suddenly, you notice that you are very cold. Instead of turning up the heat, you go and get a sweater and put it on.

TYPE OF SITUATION: AFTER
You are driving to work in your carpool. Everyone is busily discussing the latest news and sports. They are alert and seem very happy.

TYPE OF SITUATION: AFTER
You are busily sewing cloth napkins as a gift for your family. Present them to the family at dinner time. Ask them to pass you their paper napkins, as you hand out one cloth napkin for each family member. Hooray for you!

DIRECTIONS: Cut out and laminate the above cards for use in stimulation for pantomines.

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Activity No. 14

Science
Art

conservation | grade | time

"Decal It"

5

60 min.

Concept
There are various methods to conserve energy.

Objective
Given the opportunity, the student will design and construct decals which emphasize energy conservation practices.

Materials
White contact paper
Colored marking pens

Implementation
1. Discuss with students the various energy sources, their uses, and how each could be used efficiently—conserved.
2. Have the students design decals which illustrate energy conservation practices on contact paper.
3. Have the students cut out the decal with backing still on the contact paper. Have each student share their decal.
4. The decal can be used at home, in school, or in the community.

Suggested Assessment
Have the student list four ways to conserve energy.

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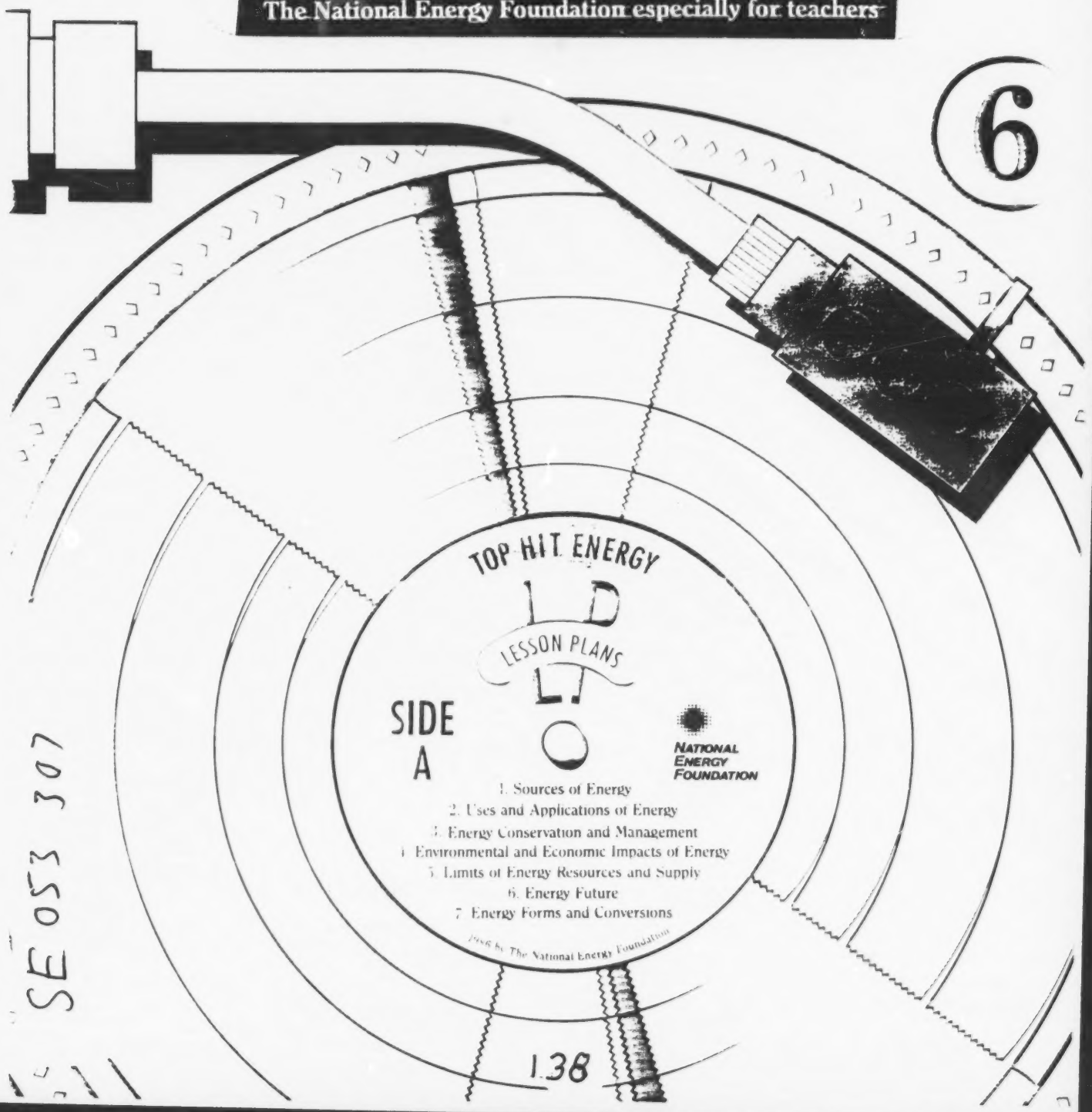
ENERGY

Multidisciplinary activities for the classroom developed by The National Energy Foundation especially for teachers

6



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NATIONAL ENERGY FOUNDATION
Resources for Education

About the National Energy Foundation

The National Energy Foundation (NEF) is a unique nonprofit educational organization devoted to the development of instructional materials and teacher and student educational programs dealing with energy. NEF is supported by resources from business, government and education. NEF's primary concern is to present energy, science, technology and contemporary issues accurately and objectively.

To the Teacher

NEF instructional materials are teacher-developed, teacher-tested and multidisciplinary. The instructional materials are developed in accordance with NEF's **Conceptual Framework**. The seven goal areas of the **Conceptional Framework** are: Sources of Energy, Uses and Applications of Energy, Energy Forms and Conversions, Environmental and Economic Impacts of Energy, Limits of Energy Resources and Supply, Energy Future, and Energy Conservation and Management. Each goal area is then divided into concepts which are necessary to a fundamental understanding of energy. Listed under each concept are simply stated objectives.

About the Elementary Lesson Plans

The enclosed elementary lesson plans and activities have been selected as those most preferred by teachers and students. They have been designed for use within NEF implementation workshops. Included within each of the activities is a complete breakdown as to the time needed for implementation, materials required, implementation procedure, assessment questions, student handout masters (for duplication), identification of optional activities or career education suggestions and other information pertaining to the successful completion of the activity.

Warning: some of the activities are potentially hazardous due to the use of flammable substances and/or heat. Please exercise extreme caution. Check your local and state laws governing the use of flammable materials in the classroom. In addition, always be alert to possible electrical hazards. Each school year should begin with a review of the safe use of electricity, and each activity involving the use of electricity should be preceded by a reminder of safety procedures.

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Resources for Education

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Activity No. 1

Science
Language Arts, Art

"Energy Source Password"

sources grade 6 time 45 min.

Concept
Energy sources can be classified in many different ways.

Objective
Given the opportunity, the student will identify and use vocabulary words related to the topic of energy sources in a game situation.

Implementation

1. The success of this activity depends upon adequate student preparation. Class time should be spent learning to spell and define the following energy source words:
   geothermal
   coal
   nuclear energy
   oil
   fission
   crude
   fossil fuels
   solar
   wind
   oil shale
   gasoline
   battery
   steam
   methane
   ocean waves
   tides
   hydroelectric
   uranium
   water
   waste
   petroleum
   biomass
   natural gas
   wood
   fusion
2. Divide the class into two groups of approximately equal ability. Choose one student from each team to give clues and have them sit at the front of the room. This game is played like the T.V. game "Password," except that each clue giver will be giving clues to his/her team rather than to one partner.
3. You may want to use the list of suggested words included, or add your own choices.
4. How the game is played:
   A. Each of the clue givers is shown a password.
   B. The clue givers then give clues alternately to their teams as to the identity of the password. Some teachers allow only one-word clues to be given—you may prefer to allow more clues within a certain time period, such as 15 seconds. (Have one student be the timekeeper.)
   C. After giving a clue, the clue giver chooses someone on his/her team to guess what the password is. If that team member guesses the correct word, his/her team scores, and you begin a new round using a new password. Alternately, team members guess the word by order of seating rather than being chosen by the clue giver to guess the word.
   D. If the team member guesses incorrectly, the turn goes to the other clue giver, who gives a new clue to a member from his/her team.
   E. After the word has been guessed correctly by one team or the other, the new word goes first to the clue giver who did not start the previous round.
   F. Scoring is as follows:
      —10 pts. for the team guessing the word correctly on the first clue.
      —9 pts. if the correct word is guessed on the second clue.
      —8 pts. if the team guesses the password after hearing the third clue, etc.
   G. New clue givers should be chosen from each team after every three or four rounds have been played.
5. Have students write a short story where the characters in the story are based on several of the Energy Source Words. Have students create a watercolor painting of their short story.

Optional Activities

1. Have the students take part in a spelling bee using the energy words. How many of these words can the student define?
2. Construct new lists of words related to CONVERSIONS of energy, USES of energy, IMPACTS of energy, FUTURE sources of energy, CONSERVATION of energy, and LIMITS of energy.

Suggested Assessment
Have students spell and define/describe the following words:
natural gas
geothermal
hydroelectric
coal
fossil fuel
uranium
petroleum
nuclear

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Activity No. 2

Science
Social Studies, Art, Language Arts

"Sources Of Energy From Past to Present"

sources	grade	time
	6	10-45 min.

Concept
Energy sources can be classified in many different ways.

Objective
Given the opportunity, the student will identify ways that technologically advanced societies have developed more sources of energy than primitive societies.

Materials
"Energy Consumption" Handout

Implementation

1. Have the students research the many sources of energy used from the time of early humans to the present. This information should then be developed into a mural.
2. Have the students keep the following questions in mind to guide them in their research: (Possible answers follow each question.)

   A. What sources of energy were used by early humans?
   —Early people used their muscles, flowing water, eventually used fire.

   B. Why did people start out using these energy sources?
   —Early humans lacked the knowledge to use more complex sources of energy and therefore used that which was readily available to them.

   C. As people began using animals to lighten their work load, what happened?
   —As animals lightened the human work load, people had more time to develop their knowledge.

   D. As human knowledge in the areas of writing, mathematics, astronomy, geography, architecture and metallurgy increased, what resulted?
   —As human knowledge increased, people gained the skills and ability to develop and use more sophisticated power sources (i.e., simple machines such as the wheel, gears, inclined plane, wedge, lever, siphon and pump.)

   E. How did the development and use of new power sources lead to the harnessing of even more sophisticated power sources?
   —The new tools or technological developments could be used to extract and develop even more and different energy sources. For example, the Newcomen steam engine was first used as a pump to drain water from a deep tin mine in England, thus making the tin available. However, it was half a century later before steam power was introduced to industry.

   F. The class might be interested in doing some research on steam engines at this point.

   G. What are some of the energy sources that we now use daily. Common energy sources used daily are: gasoline, oil, natural gas, electricity, coal, wood, solar, wind, and geothermal. Electricity is a form of energy.

   H. What are some of the new energy sources we are now developing and putting to use?
   —Some of the "new" sources we are starting to use really aren't so new, but are just starting to be developed, such as solar power, geothermal power, wind power, nuclear power.

   I. Compare the number of energy sources and the amount of energy being used in the United States with a less technologically advanced country such as South America or Africa. Would you say that a technologically advanced society uses more or less energy? Why?
   —See the enclosed chart for comparisons of energy consumption in several countries.
   —Technologically advanced societies use more energy from more energy sources because they have the know-how, the money, and the technology to develop sites to make more energy available, just as the steam engine was used to pump water to make tin available in question "E."

Suggested Career Awareness Activity
Students may research and report on the development of various careers created by increased use of technology. This study would cover careers evolving from the industrial revolution up to the present.

Suggested Assessment
Have students write a short story about how technological changes influence the use of energy sources.

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ENERGY CONSUMPTION

Name _____ Date _____

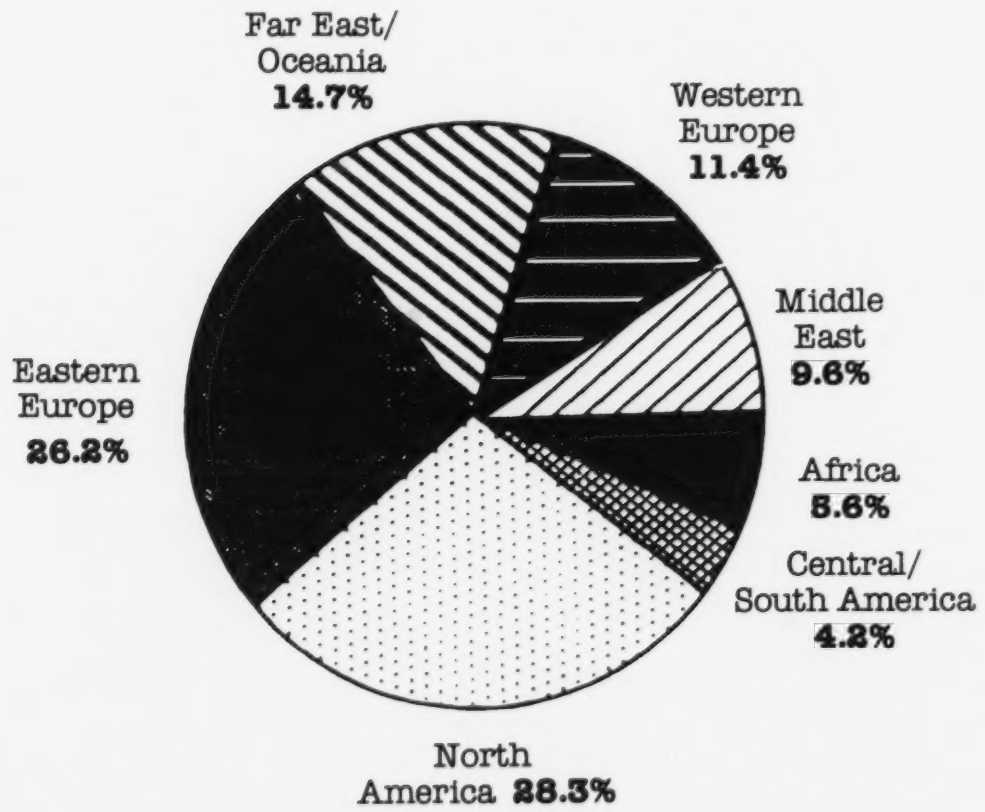
Questions:

1. Which of the seven world areas do you think is the most technologically advanced? Why?

2. Rank the seven world areas in order of their technological standard, with 1 being the most technologically advanced. Explain your ranking.

3. Based on the "World Energy Consumption" pie graph, rank the seven world areas in order of energy consumption, with 1 consuming the most energy.

4. What relationship can you observe between your rankings?



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Activity No. 3

Science

Social Studies, Art, Language Arts

uses	grade	time
	6	3-45 min.

"Energy Trip Ticket Game"

Concept
Every energy use decision affects standards of living and quality of life.

Objective
Given the opportunity, the student will be able to recognize that energy conservation affects our standards of life.

Materials
Magazines
Glue
Paper/poster board
Energy Trip Tickets (master included)

Implementation

1. Using magazine pictures, have students make collages depicting the use of energy in the following areas:
   A. Things we use at home.
   B. Things we use and do for fun.
   C. Things we use for transportation.
   D. Things we do for work (jobs).

   You may want to put students in small groups to work on the collages, sharing with the rest of the class when they are finished.

2. Class discussion: Compare the use of energy depicted by each collage. How are they alike? How are they different?
   A. Which items on our collages make our lives easier and more comfortable? How?
   B. Discuss the idea that it takes a lot of energy to have and do the things depicted on the collages.
   C. What energy sources are used to do the things depicted on the collages?

3. The "Energy Trip Ticket Game"
   A. Make a standardized energy ticket on the ditto master or use the master provided.

   Give each student 50 tickets. (Some teachers find that if you give each student only 5 tickets per day, it helps to control the lesson being learned. Five new tickets may be issued each day until the completion of the lesson.) Have the student place his/her name on each of the tickets. Play the game for 3 weeks. The time can be shortened or lengthened by providing more or less energy trip tickets.

   B. List several places the students go in school and charge one energy ticket for the cost of each trip:
   pencil sharpener
   drinking fountain
   restroom
   lunch
   recess
   music/p.e.
   library

   C. Each time the student takes a trip it costs one energy ticket. Place a folder or box on or near the door and have students put the tickets there for collection. If a student runs out of tickets, they cannot take any trips.

   D. Keep a record of how many tickets the students have used each day. Discuss which students are wasting energy. Which students are conserving energy? How are they doing it? Also discuss energy saving ideas for trips in the classroom (e.g., at recess I can get a drink, sharpen my pencil and go to the restroom for 1 ticket. Otherwise it would cost me 4 tickets if I did them one at a time.) This stresses the idea that in one trip we can accomplish several things.

   E. On the third day of the second week, discuss the idea of running out of energy tickets. There are no energy tickets left for the rest of the week. What can we do to save? What will it cost?

   F. At the end of the game discuss what impacts conservation had on the quality of the students' classroom life. How did an "energy shortage" affect their energy use?

4. Relate the game to the actual use of energy depicted by the collages the students made. Consider the following:
   A. It takes energy to supply the things people use to make their lives easier, more comfortable, or enjoyable. How might energy conservation or an energy shortage impact the activities depicted in the collages?
   B. How might energy use decisions affect standard of living and quality of life?

5. Discuss how students and their parents can conserve energy.

6. Have the students write a story about "THE DAY THE ENERGY RAN OUT."

Suggested Assessment
Have students explain how conservation might affect their use of energy, standard of living and quality of life.

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National Energy Foundation
ENERGY
TRIP TICKET
Name

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Activity No. 4

Mathematics
Social Studies, Science

uses	grade	time
	6	2-60 min.

"Meter Reading"

Concept
Each form of energy can be used in many ways.

Objective
Given the opportunity, the student will list ways by which energy is used; and measure how much energy they use at home.

Materials
How to Read Your Electric and Gas Meter
Meter Reading Record
Meter Reading Worksheet

Implementation

1. List on the chalkboard the following energy sources/forms: natural gas, oil and electricity. Remember, electricity is a form of energy that we use. Have students identify ways in which each source/form is used. Some examples:

   Natural Gas
   heat buildings — fertilizers
   heat water — clothing
   cook food

   Oil
   heat buildings — fertilizers
   make gasoline — clothing

   Electricity
   heat building — cook food
   heat water — operate appliances

2. Discuss with students how each energy source/form is measured when it is used. Why do we measure the use?
   A. Ask: How do we measure the use of gasoline?
   B. Inform students that natural gas is measured by a gas meter which measures how many cubic feet of natural gas is consumed. Explain what a cubic foot is.
   C. Inform students that electricity is measured by an electric meter. Electricity used is measured in kilowatt-hours (kWh). A kilowatt hour is the number of kilowatts used in one hour. A kilowatt is equal to 1000 watts. For example, a 100 watt light bulb consumes 100 watts per hour or 0.1 kWh.
3. Inform students that they are going to determine how much energy (electricity and/or natural gas) their family uses in one week. Tell them they will do this by reading their electric and/or gas meter every day at the same time.
   A. To prepare students to read their electrical or natural gas meter, provide them with a copy of "How to Read Your Electric and Gas Meter." Go over the instructions with the students so that they will be able to read their electric and/or gas meter.
   B. Provide each student with the "Meter Reading Worksheet" and have students complete the worksheet. Go over the worksheet with students.

   NOTE: Some electric and gas meters may have 5 faces instead of 4.
4. Have students read their electric and/or gas meter every day for one week. Be sure they read it at the same time each day.

   Provide students with a copy of the "Meter Reading Record" to record their data.
5. At the end of one week have them calculate how much energy (natural gas and/or electricity) their family used. To determine the amount, subtract the first reading from the last. Have the students share and discuss their results. Ask:
   A. Why do the amounts differ from student to student?
   B. How might weather affect energy consumption?
   C. How might the number of people in the family influence energy consumption?
   D. How might the size, age, insulation/weatherization, etc. of homes influence energy consumption?
   E. What were some ways your family used electricity and/or natural gas during the week?
6. Have students make a line graph of their family's daily energy use. Ask:
   A. Does their energy use differ from day to day. If so, why?
   B. Which day did your family use the most energy. Why?
7. Have students suggest ways in which they might conserve energy.
8. You may wish to have students determine the cost of using the energy for the week. Contact your electric or gas company for your rate.

Optional Activity
Teacher may wish to conduct this activity several times during the year (fall, winter, spring) to have student collect actual energy consumption data.

Suggested Assessment
Have students read an electric or natural gas meter.

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Activity No. 4

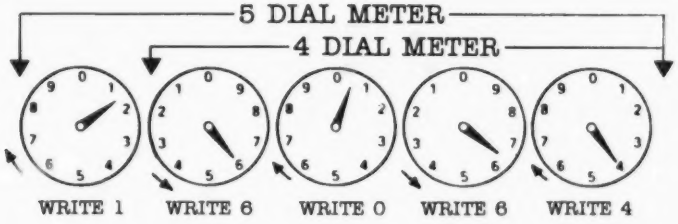
"Meter Reading"

HOW TO READ YOUR ELECTRIC AND GAS METER

Name: _____ Date: _____

How To Read Your Electric Meter

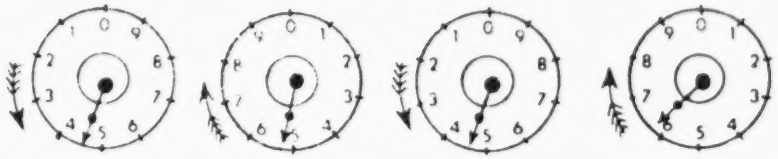
The dials are like watch faces lined in a row (every other dial moves counterclockwise). The reading for a five dial meter would be 16,064. The reading for a four diameter would be 6,064.



Notice that when the pointer is between two numbers, you should record the lower of the two numbers.

When the pointer seems to be directly on a number, look at the dial to the right, if the pointer on the right side dial has passed "0," then write down the number the pointer seems to be on; if the pointer on the right side dial has not passed "0." then write down the previous lower number on the dial you are recording.

How To Read Your Gas Meter



4

Take the number the first pointer has just passed...

4

And the number the third pointer has just passed...

5

And the number the second pointer has just passed...

6

And the number the second pointer has just passed...

Add two zeros 454600
This is the meter reading (in cubic feet of gas).

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Activity No. 4

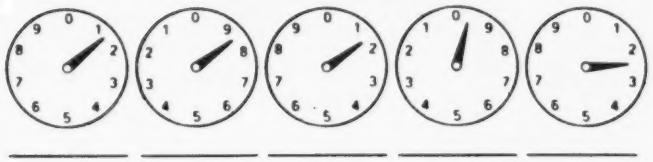
"Meter Reading"

"METER READING WORKSHEET"

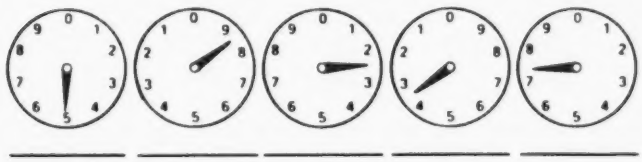
Name: _____ Date: _____

Read the following meters and record your answers in the space below each.

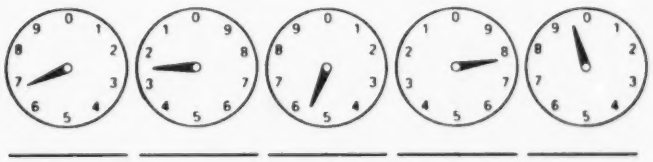
Electric Meters



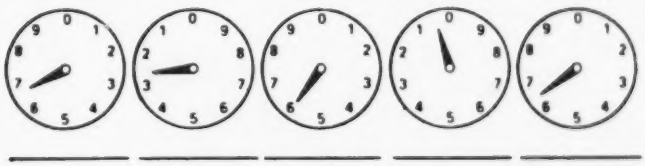
_____ _____ _____ _____ _____



_____ _____ _____ _____ _____

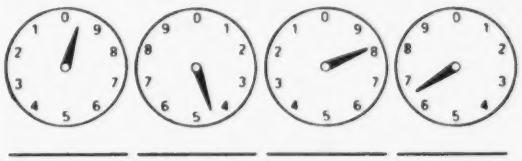


_____ _____ _____ _____ _____

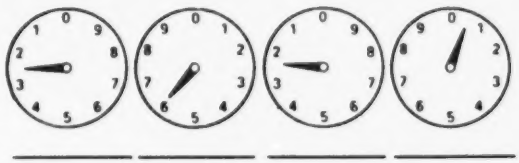


_____ _____ _____ _____ _____

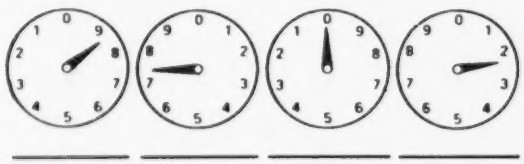
Gas Meters



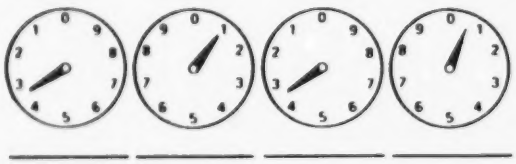
_____ _____ _____ _____



_____ _____ _____ _____



_____ _____ _____ _____



_____ _____ _____ _____

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METER READING RECORD

Name: _____ Date: _____

ARE YOU SAVING ENERGY? A good way to find out is to keep a record of the electricity or natural gas you use before and after beginning your conservation effort. The chart below will help you record your progress. 1. Draw the positions of the hands of the meter on the dials each day at the same time. 2. Write the number in the space below each dial and on the line at the right. 3. Subtract the readings on day one from day two. Repeat each day for seven days.

☐ Electric Meter ☐ Natural Gas Meter

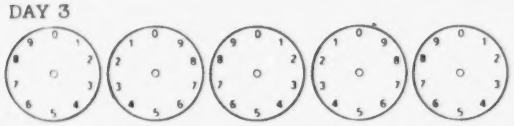
DAY 1

Meter Reading Day 1 _____

DAY 2

Reading Day 2 _____
Reading Day 1 _____
Energy used _____

DAY 3



Reading Day 3 _____
Reading Day 2 _____
Energy used _____

DAY 4

Reading Day 4 _____
Reading Day 3 _____
Energy used _____

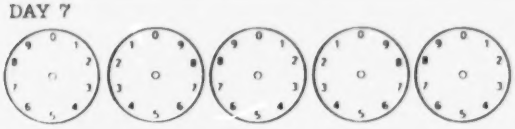
DAY 5

Reading Day 5 _____
Reading Day 4 _____
Energy used _____

DAY 6

Reading Day 6 _____
Reading Day 5 _____
Energy used _____

DAY 7



Reading Day 7 _____
Reading Day 6 _____
Energy used _____

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Activity No. 5

Science
Mathematics, Art

"My Radiometer"

conversions

grade 6

time 60 min.

Concept
There are human made and natural conversion systems.

Objective
Given the opportunity, the student will be able to observe the conversion of light into mechanical energy (moving paddles).

Materials
Radiometer
(Windsor Electronics, Inc.
P.O. Box 662
Wheaton, IL 60187
(312) 663-4171)
Electric lamp, approximately 150 watts
Opaque sheet of paper

Implementation

1. Place the radiometer in the sun and observe. Discuss with students: Does this prove that the sun is a source of energy? What forms of energy come from the sun (heat, light, radiation). Inform students that the sun's energy is converted by the radiometer to mechanical energy (moving paddles).
2. Conduct the following radiometer demonstration.
   A. Set a radiometer and a lamp on a level table or counter approximately 60 cm from each other. Focusing the lamp on the radiometer, turn on the lamp and observe the radiometer. Count the number of turns the paddles make in 1 minute. Inform students that the lamp is converting electrical energy into light and heat energy.
   B. Next, vary the distance between the lamp and the radiometer from 30 cm to 1 m and observe the radiometer, again count the turns in 1 minute.
   C. With the lamp 30 cm away from the radiometer, alternately hold and take away an opaque piece of paper in front of the lamp. Note the effects of the speed and completeness with which you block the light on the radiometer. Again count the turns in 1 minute.
   D. Make a bar graph illustrating your data—the number of turns in 1 minute per investigation.

      NOTE: If you have more than 1 radiometer, have the students in groups conduct the investigation.
   E. Questions for class discussion:
      1. What effect does intensity of light (distance and/or shading) have on the radiometer?
      2. What are some ways a radiometer could be used for doing work?
      3. How might the sun be used as an energy source?
3. Discuss with students that we must also convert the stored energy of coal, oil, natural gas and uranium (nuclear) in order to use their energy. Inform them that the energy of coal, oil and natural gas is stored as chemical energy and through burning is converted to heat and light energy, and that the energy of uranium is converted through nuclear reactions—the splitting of the atom (fission) to heat energy.

Suggested Career Awareness Activity
Students role-play being a science design engineer by drawing an illustration of how the radiometer concept could be used on a large scale to produce electrical power. Allow students to be creative. Have them share their illustration with others.

Suggested Assessment
Draw a line through the word(s) to make the following sentences correct:

1. The sun's energy is in the form of heat, light, chemical, and radiation.
2. The energy of coal, oil, natural gas and uranium is converted through burning.
3. The radiometer converts the sun's energy into light and mechanical energy.
4. A lamp or other household appliance converts electrical energy into heat, light and chemical energy.

Answers
Words to be crossed out:

1. Chemical
2. Uranium
3. Light
4. Chemical

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Activity No. 6

Science
Mathematics, Language Arts

"Light Energy to Heat Energy"

conversions | grade | time

6 | 4-30 min.

Concept
There are human made and natural conversion systems.

Objective
Given the opportunity, the student will observe that light energy can be converted to heat energy—an example of a natural energy conversion.

Materials
2 thermometers
Clear quart jar with lid
2 file cards
Lamp, approximately 150 watts
Graph paper

Implementation

1. Fasten two small thermometers to file cards. The cards will act as shades for the thermometers so that they will respond to the air temperature around them and not to the direct heating of the light bulb.
2. Place one thermometer in a jar and secure the lid. Place the other thermometer in a similar position next to the jar.
3. Place a lamp within one or two feet of the thermometers, an equal distance from both of them. The thermometers themselves should be behind the file cards in relation to the light source. If convenient, direct sunlight could (should) be used instead of the lamp.
4. The temperature of both thermometers should be read initially and at one minute intervals over at least a 20 minute period. Record data on chalkboard.
5. Questions:
   A. Which thermometer indicated the greater temperature change?
   B. What role did the closed glass jar have in the changing (conversion) of light energy to heat energy?
   C. Can you think of some common useful examples of this experience on a large scale?
   D. What was the energy source for the light? If a lamp was used, explain that the electrical energy was converted to light and heat energy by the light bulb.
6. Have students create a line graph of the data, plot temperature versus time. Use different colored inks for the thermometers.
7. Have students research one solar energy technology, writing a one page report on it; photovoltaics, solar ponds, passive and active solar systems, power towers. Have students relate the investigation to the technology they have researched. You may want to put the students in teams and have them make an oral presentation.

   NOTE: If you have enough equipment you may want the students to conduct the investigation in groups.

Suggested Assessment
Match the solar technology to the correct description:

1. Photovoltaics
2. Solar ponds
3. Passive solar systems
4. Active solar systems
5. Power towers

A. Use chemically treated ponds to absorb the sun's heat.
B. Converts light energy to electrical energy.
C. The sun's energy is concentrated by mirrors to produce heat.
D. The sun's energy is absorbed by water drums, heating the water which is used by people.
E. Pumps or fans are used to move the heat obtained from the sun.

Answers
1-B, 2-A, 3-D, 4-E, 5-C

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Activity No. 7

Science
Social Studies, Art, Language Art

"Bagasse"

impacts | grade | time

6 | 4-45 min.

Concept
The use or nonuse of an energy source requires environmental and economic trade-offs.

Objective
Given the opportunity, the student will be able to explain how bagasse (sugar cane waste) is being used as a clean energy source rather than a pollutant, and to list other industries which are changing wastes into useful energy sources.

Materials
Cane Power Plant Diagram
Big Isle energy source article by Hugh Clark

Implementation
1. Review the enclosed article "Big Isle Energy Source" and have the class discuss and make a study of how industry has converted a pollutant into a clean, useful energy source. Discuss the economic advantages of generating electricity from bagasse.
2. Make a flow-process chart (an example is enclosed) showing how the bagasse (sugar cane waste) was originally wasted and dumped into the ocean. Compare this to the way it is now used as an energy source for the generation of electricity.
3. Have students conduct library research to develop a written plan to extract natural gas from garbage dumps, or how garbage can be used to generate electricity. Have students include drawings and flow charts. Be sure students include the economic and environmental aspects of such plans.

Suggested Assessment
What is bagasse and how is it used as an energy source instead of a pollutant?

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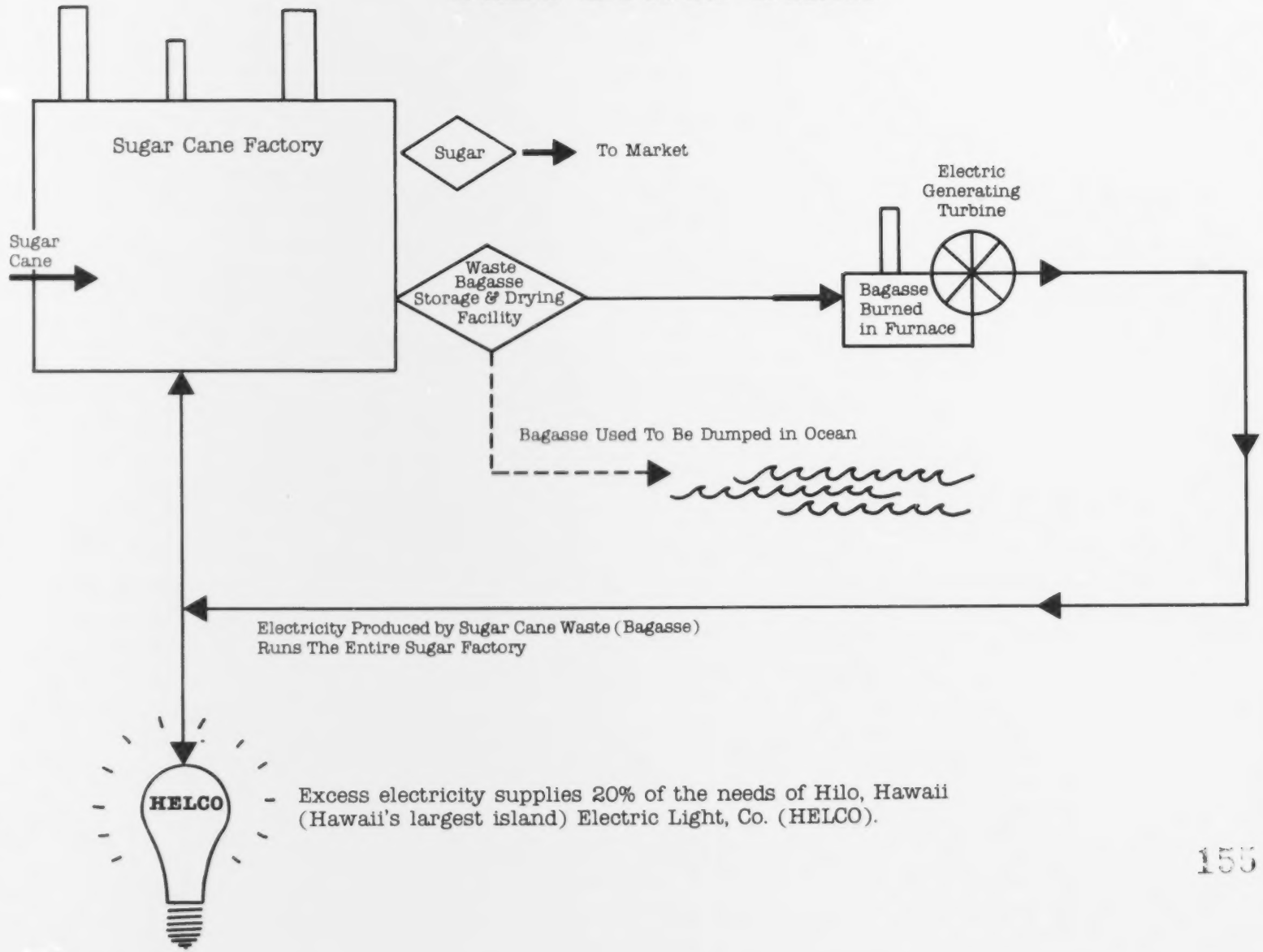
Cane Power Plant


Sugar Cane Factory
Sugar
To Market
Electric Generating Turbine
Sugar Cane
Waste Bagasse Storage & Drying Facility
Bagasse Burned in Furnace
Bagasse Used To Be Dumped in Ocean
Electricity Produced by Sugar Cane Waste (Bagasse) Runs The Entire Sugar Factory
HELCO

Excess electricity supplies 20% of the needs of Hilo, Hawaii (Hawaii's largest island) Electric Light, Co. (HELCO).

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Big Isle Energy Source

CANE POWER PLANT

By Hugh Clark
Advertiser Big Island Bureau

Pepeekeo, Hawaii—C. Brewer is about to fire up the Island's largest nonfossil-fuel electric-generating plant, designed to operate on cane trash which used to be dumped in the sea.

The $9 million Pepeekeo power plant—which will produce up to 24 kilowatts an hour—is being completed as part of a larger $27 million expansion, modernization and pollution-abatement program by the Brewer firm.

Acting Gov. George Ariyoshi and industry, union and community leaders will speak at the 10:30 a.m. program for 150 invited guests at the factory site. Public tours will begin at 3 p.m.

The power plant will produce enough electricity to run the entire Pepeekeo factory and provide 20 percent of the Big Island's commercial needs for Hilo Electric Light Co. (HELCO).

HELCO is buying the excess energy generated from the 80-foot-high furnace, which will consume up to 1,500 tons of bagasse a day.

The bagasse-cane from which sugar has been extracted—is stored in an adjoining holding facility. An automatic bagasse shovel will feed the furnace. It is operated by men located in the power plant several dozen yards away in a control room using isolated television monitors.

The entire power plant, the most modern in Hawaii, will require just three men per shift for operations. They come from a pool of 14 men whom Brewer trained.

The plant is scheduled to begin generating power on Monday for energy-starved HELCO, which has been hard-pressed to keep up with the Big Island's demands.

The plant is scheduled to use only bagasse as a power source. Bagasse had been dumped into the nearby ocean as waste until now.

In the early stages, however, the plant is to be supplemented by fuel oil to provide for HELCO's needs.

The natural-energy plant is the featured attraction in the over-all $27 million investment which Hilo Coast Processing is making here.

The former Ewa Sugar Co. mill has been brought here from Oahu and completely rebuilt to provide a 3,600-ton-per-day sugar mill that becomes the largest on the Big Island.

It will be responsible for replacing three existing factories being operated by Brewer—including Hakalau and Wainaku, which are being shut down at the end of the year. The former Pepeekeo mill is being converted to a cleaning and bagasse-de-watering unit to prepare the fuel for the furnace at the power plant.

A related $2.6 million project at the Papaikou mill to meet Federal pollution standards is involved in the over-all Hilo Coast updating program.

Completion of the project here is the result of seven years of planning for sugar's future on the Hilo coast. Brewer in 1967 considered either a merged and expanded-factory program or going out of business to meet the twin challenges of quitting pollution practices and rehabilitating factories built before 1910.

Although the completion of the equipment here will stop the practice of dumping cane wastes into the ocean, Hilo Coast has two more years to develop water-treatment facilities to halt the outflow of dirty water containing rocks and mud.

By 1976, a cleansing program was expected to remove 97 percent of all soil pollutants. The recovered material will be used for road building and field repair as the preliminary steps in a long-range land-reclamation program.

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Activity No. 8

Science
Mathematics

"Select A Site"

limits | grade | time

6 | 60 min.

Concept
Energy resources are unevenly distributed.

Objective
Given the opportunity, the student will use a manipulative concrete experience to help him/her understand how coal resources are deposited.

Materials
Graph paper
Chocolate chip cookies
Napkins
Paper clips

Implementation

1. Each child is given a cookie and a napkin. They are not to eat any part of the cookie at this time!
2. Tell the students that the cookie represents their country or state. The tan particles represent the earth's crust and the chocolate chips represent the coal deposits.
3. Instruct students to count how many visible chunks of coal are in their country. Count only the coal deposits visible from the top.
4. Provide students with graph paper and have the students create a bar graph to illustrate the visible chunks of coal for their country or state. Record class data on chalkboard.
5. Now have each student predict how many coal deposits they think they have in their country or state.
6. Provide each student with a paper clip and instruct them to begin mining their coal deposits. Have them place their coal deposits in one pile and the earth's crust in another.
7. Next, have students count the coal deposits and prepare a bar graph next to their first graph. Record the class data on the chalkboard.
8. Compare and contrast the number of coal deposits visibly observed and actually in existence. How does the actual number of coal deposits compare to their prediction?
9. Have students make a histogram of the class data for coal deposits observed and extracted. Discuss the range, mean (average), median and mode.
10. What conclusions can the students draw? Lead a discussion which elicits the following points:
    A. Our data tells us that there were more "coal deposits" than could be seen on the surface.
    B. "Mining" the deeper coal took more time and was more trouble than mining coal near the surface. (It takes energy to get energy.)
    C. "Mining" the coal has environmental impacts.
    D. The coal deposits were unevenly distributed. Some students had more coal deposits than others.
11. As an extension, you may wish to show the students a U.S. map of coal deposits which illustrates that some states have more coal deposits than others. Your school librarian should be able to assist you in locating a reference book with a map.

Suggested Assessment

1. What can you say about the distribution of energy?
2. True or false, it takes energy to obtain energy?
3. Can we get energy without impacting the environment? Explain.

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Activity No. 9

Science

Social Studies, Art, Language Arts

limits	grade	time
	6	6-45 min.

"Search for Minerals"

Concept
Energy resources are unevenly distributed.

Objective
Given the opportunity through library research, the student will learn that energy sources are unevenly distributed around the earth.

Materials
Paper/poster board
Markers

Implementation

1. Students should realize that natural processes are constantly forming and concentrating energy sources, thus determining the location of these energy sources.

   Have the class discuss what is meant by "natural processes." Have the students give examples of natural processes. Some examples would be:

   —Coal changing into diamonds after undergoing centuries of heat and pressure.

   —Geothermal energy generated by the decay of natural radioactive materials within the earth. (This is in addition to the heat energy remaining within the earth from the gravitational formation of the earth.)

   —Oil and natural gas formed from the decay of ancient marine life.

   —Coal formed from ancient plant life.

2. Have the students write to their state department of natural resources for information on the state's mineral and energy resources and their location.

3. Have each student draw a state map, indentifying and depicting the location of the state's principal energy and mineral resources.

4. Have students divide into groups. Either assign, or have each group choose a continent, or U.S. state to research the major minerals, energy sources, and their location. For comparison, all groups should either research continents or U.S. states.

   Have each group draw a large map of their state or continent, naming and locating the major minerals and energy sources. Each map must be accompanied by a key. (The teacher might also require a bar graph showing the percentage of each mineral or energy source located on the map.)

5. Post the completed maps around the classroom. Ask the students to compare the maps. Which minerals/energy sources are predominant? Which are less common? Are these sources evenly distributed? How would you explain this? What limits does this distribution of minerals/energy sources have on continents/states? (This discussion may be expanded upon as the teacher desires. One may or may not want to get into the subject of the effect of energy-source distribution on international relations.)

Suggested Career Awareness Activity
Have students identify jobs involved with the use of major minerals found in their research.

Suggested Assessment
On an 8½" x 11" map of the students' state, have them indicate where the major mineral and energy sources are located.

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Activity No. 10

Social Studies
Language Arts, Art, Science

limits	grade	time
	6	2-45 min.

"Burning Springs and Other Hot Spots"

Concept
The availability of energy resources is influenced by availability of technology.

Objective
When given the appropriate background information, the student will identify natural gas as a source of energy by drawing and explaining a pictorial natural gas timeline.

Materials
Background Information Sheet
Word Picture Strips
Paper, crayons, pencils, butcher paper, felt pens

Implementation

1. Distribute Background Information Sheet and instruct students to read. Indicate that the information on the sheet will be used to create a timeline display for one side of the room.
2. Discuss the information contained on the Background Information Sheet. Some appropriate discussion questions are:
   A. What came from the springs in the Kanawha River Valley and Fredonia that could burn? (natural gas)
   B. How deep was the natural gas well at Fredonia? (27 feet)
   C. Why do you think the natural gas was so close to the surface? (various answers)
   D. How could natural gas be a nuisance? (It interfered with salt mining.)
   E. Why wasn't natural gas initially considered as valuable as oil? (Because it couldn't be transported.)
   F. What main factor led to natural gas becoming a useful source of energy? (Construction of pipelines.)
   G. How did technology influence the availability of natural gas? (Provide for transportation.)
   H. What was limiting natural gas as an energy source? (Transportation.)
3. Cut the Word Picture Sheet into strips.
4. Distribute strips to groups of students with the instruction that each group is to make a sketch that depicts their word picture.
5. Place a strip of butcher paper on the floor. Mark the paper off in 1 meter sections with each identified by a date from the Word Picture Strips.
6. Have groups of students redo their sketches as final pictures on the butcher paper under the appropriate dates.
7. Place the Natural Gas Development Timeline on a wall.
8. Have each group tell about their word pictures.

Optional
You may wish to have each student create their own picture storybook about the history of natural gas. Use Word Picture Strips as picture headings.

Suggested Career Awareness Activity
Invite a local gas company representative to visit the class to share the story of local gas development.

Suggested Assessment
How does the availability of technology influence the availability and use of energy sources?

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BACKGROUND INFORMATION SHEET

Name: _____ Date: _____

General George Washington and General Andrew Lewis were given land for some of their army service. The land surrounded "Burning Spring" in the Kanawha River Valley. Little did they realize how important this burning gas would become to millions of people.

Almost fifty years later, another burning spring was discovered at Fredonia, New York. The spring was discovered by accidentally lighting a vent in the ground. A well was sunk and natural gas was discovered at only 27 feet. The natural gas was used for lighting. At 2:00 a.m., June 4, 1825, many people gathered under this light to greet visiting General Lafayette. Refreshments were served to all.

The inflammable gas from the earth was treated as a curiosity for many years. The salt producers considered it a nuisance until they began to use it as a fuel to evaporate brine.

In 1859 oil was struck in the area around Titusville, Pennsylvania. This strike marked the birth of the Petroleum Industry in the United States. In searching for oil, many discoveries of natural gas were made. Only the oil was valued, because it could be stored and transported. Many natural gas wells were allowed to blow off into the air, hoping that oil would follow.

It was not long, though, until American ingenuity and enterprise began to recognize the possibilities of this rich fuel and to devise means of carrying it to market. The first major experiment of this kind was undertaken with the building of twenty-five miles of pipeline from wells at West Bloomfield, New York, to serve the city of Rochester. The pipeline was constructed of white pine logs, trimmed to a diameter of one foot and bored to eight inches. During the Winter of 1872, the natural gas was finally turned into the mains at Rochester, but the service proved unsatisfactory. It was also in 1872 that the first iron pipeline, five and a half miles long, was laid to bring waste natural gas from nearby oil wells to Titusville. This venture was successful.

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WORD PICTURE STRIPS

Name: _____ Date: _____

2000 B.C.
Chinese pipe natural gas through bamboo poles. They burned the gas to evaporate salt water and collect the salt.

600 A.D.
Temples near what is Baku, Russia had "eternal fires." Worshippers came from as far away as Persia and India to marvel at the power of the temple priests.

1609 A.D.
Jan Baptista van Helmonts discovered a "spirit" that escaped from heated coal. He named the burning material "gas."

Late 1600s.
John Clayton collected gas in animal bladders. He then punched holes in the bladders and lit the escaping gas.

1775
French missionaries report seeing "pillars of fire" in the Ohio Valley.

1821
Natural gas discovered in Fredonia, New York. A well was drilled and natural gas was struck at 27 feet.

1872
The first iron pipeline was built to transmit natural gas five and a half miles to Titusville.

1920s
Natural gas production has reached 80 billion cubic feet a year.

1930s
Pipelines carried natural gas from Texas to the Midwest. The fuel became important for heating and cooking.

1960s
More than 500,000 different chemical compounds are made from natural gas and oil. These chemicals are used in detergents, drugs, fertilizers, paints, plastics, synthetic rubber, nylon and rayon.

1970s
More natural gas is being used than the amount of newly discovered gas.

1980s
A fleet of ships are used to transport liquified natural gas (LNG) across the oceans.

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Activity No. 11

Social Studies
Science, Art

future	grade	time
	6	60 min.

"The Choice is Yours"

Concept
Energy availability will affect future lifestyles and cultural conditions.

Objective
Given the opportunity, the student will consider several choices that may be taken to help us meet the energy needs of the future, make judgments of the choices offered, and be able to defend his/her selections.

Materials
Paper/poster board
Markers

Implementation

1. The following five statements are written on the chalkboard or handed out on ditto sheets. The statements present various points of view on possible solutions to our future energy needs.

   A. Electrical energy is the key to economic growth; if we must pollute the environment to get the electricity, it is a small price to pay.

   B. Natural gas should be used for space heating so we can conserve and manage electricity for other jobs.

   C. Oil, which is refined to produce gasoline, could be in short supply in the years ahead; but, if this generation can operate with the available supply, the next generation can take care of itself.

   D. If our lifestyle can be changed so that we use less material goods and, consquently, less energy we must do so, even if it means going back to a 1900 standard of living.

   E. We must have a clean environment even at the cost of economic growth and standard of living; therefore, any fuel that will be used to generate electricity or energy source that will cause pollution should be banned from use.

   F. It is probably necessary that we will have some pollution in our efforts to produce enough electrical energy in the years ahead; we should accept this as necessary to gain economic growth and maintain our standard of living.

2. Each student is then asked to rank these statements on an individual basis from most desirable to least desirable. Briefly explain his/her ranking in writing.

3. The class is then split into groups of three to six students. Each group is asked to come up with a rank order of the statements, which will necessitate an individual stating his/her choices and then arriving at a group consensus.

4. Each group will then report its ranking to the rest of the class with discussion concerning reasons for their choices.

Suggested Assessment
Have each student create a picture depicting what the future would be like if one of the six statements was true.

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Activity No. 12

Art
Science, Language Arts

future	grade	time
?	6	4-30 min.

"An Artistic Creation!"

Concept
New energy technologies may be developed in the future.

Objective
Given the opportunity, the student will create and design, using available art materials, an *energy-producing* model limited only by imagination and materials available on earth.

Materials
Paper
Paints
Crayons
Pens
Pencils
Scissors
Rulers

Implementation
1. Hold a class discussion posing the following questions and write the responses on the chalkboard:
   A. What is energy?
   B. Where does energy come from?
2. As an art project, ask the students to create a model or depiction of an energy-producing model. Allow necessary time to complete project.
3. Each student should present and explain his/her model to the class.

Suggested Career Awareness Activity
As a class, select one of the students imaginative solutions and create the job responsibilities needed to operate the invention.

Suggested Assessment
Have students write a short story describing a new energy technology. The students should include the energy source it uses, what it does, and how it works.

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Activity No. 13

Science
Mathematics

conservation | grade | time

"Watts the Difference"

6

60 min.

Concept
There are various methods to conserve energy.

Objective
Given the opportunity to gather data from information on light bulb packages, students will be able to compare durability and lifetime of various types of bulbs and will be able to predict which will last the longest.

Materials
Light Bulb Survey

Implementation

1. Discuss with students how a light bulb works and the parts of a light bulb. A light bulb converts electrical energy into heat and light energy. The conversion is due to the resistance of the filament to the electric current (electricity). You may want to make an overhead transparency of the enclosed light bulb diagram.
2. Have the students examine several different types of light bulbs, including the light bulb packages. Have them decide which are most efficient in relationship to lifetime, wattage, and amount of light produced. Explain that a *lumen* is a measure of light equivalent to a certain number of lighted candles. Remind them that a *watt* is a unit of electrical power, and that electricity is used in kilowatt-hours (kWh). A kilowatt-hour is the number of kilowatts (1,000 watts) used per hour.
3. Distribute the "Light Bulb Survey" to each student and have them survey the types of bulbs found in their homes, recording the information for wattage, lumens, and lifetime for each type of bulb. You may even want students to survey the light bulbs sold in a store.
4. Have each student calculate the electricity used in kWh by each type of light bulb in its life time:

   $$kWh = \text{hours of life} \times \frac{\text{wattage}}{1000}$$

   You may wish to have students calculate the cost for operating each light bulb for its life. You can obtain your electric rate from your local utility. To determine the cost, simply multiply the rate by the total kWh.
5. Ask the students to share their information and decide which bulb may be more efficient considering time, illumination (lumens) and wattage. Ask them how the type of light bulb used would affect the conservation of electricity.
6. Have the students construct graphs to represent the relationship between wattage and illumination; the kWh consumed in its life and the lifetime cost of operation.

Suggested Assessment

1. A lumen is:
   A. The amount of electricity used by a light bulb.
   B. The rate at which electricity is calculated.
   C. The amount of light produced by a light bulb.
   D. All of the above.
2. A watt is:
   A. The amount of electricity used by a light bulb.
   B. A unit of electrical power.
   C. 1/1000 of a kilowatt.
   D. All of the above.
3. If you use a 75 watt lightbulb for 5 hours, how many kilowatt-hours (kWh) of electricity did you use?
   A. .375 kWh
   B. 375 kWh
   C. 3.75 kWh
   D. 37.5 kWh
4. The light bulb converts electricity into light through:
   A. A fuse.
   B. Resistance.
   C. Pressure.
   D. None of the above.

Answers
1-C, 2-D, 3-A, 4-B

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Activity No. 13

"Watts the Difference"

LIGHT BULB SURVEY

Name: _____ Date: _____

Type	Wattage	Lumens Produced	Lifetime	Electricity Consumption	Lifetime Cost

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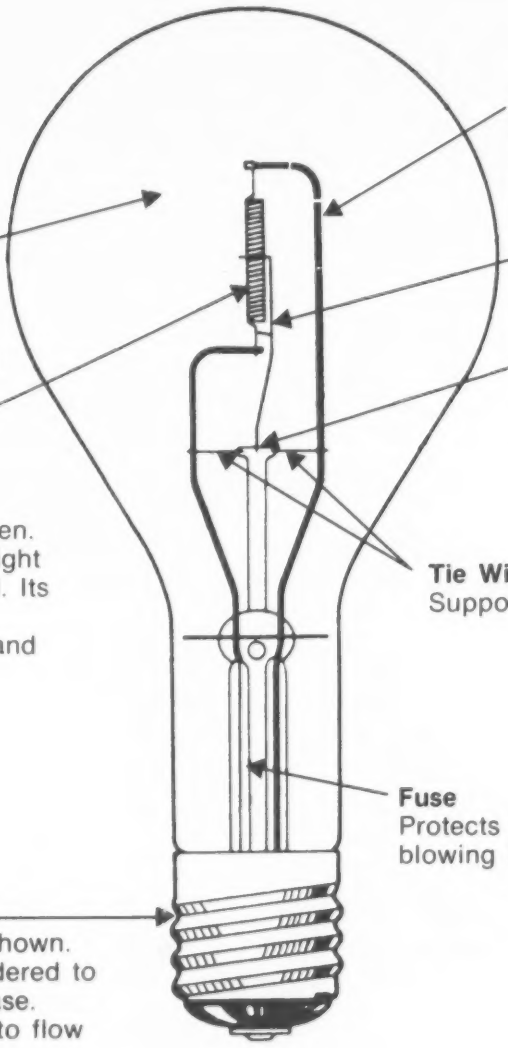
Typical Light Bulb

Light Bulb
Soft glass is generally used. Hard glass is used for some lamps to withstand higher bulb temperatures and for added protection against bulb breakage due to moisture. Bulbs are made in various shapes and finishes.



Lead-in Wires
Carry the electric current to and from the filament.

Support Wires
Support the filament.

Button
Supports tie wires.

Gas
A mixture of nitrogen and argon is used to retard rapid burning of the filament.

Filament
Is generally made of tungsten. The filament may be a straight wire, a coil, or a coiled coil. Its resistive property converts electrical energy into heat and light energy.

Tie Wires
Support lead-in wires.

Fuse
Protects the lamp and circuit by blowing if the filament arcs.

Base
Typical screw base is shown. One lead-in wire is soldered to the upper rim of the base. Allows electric current to flow through light bulb.

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Activity No. 14

Science
Language Arts

conservation | grade | time

"Keep It Cool!"

6

2-45 min.

Concept
Technological development affects energy conservation options.

Objective
Given the opportunity to experiment with ice cubes, the student will understand that some technologies and activities use more energy than others.

Materials
Ice cubes
A variety of materials

Implementation

1. Have each student work with a partner. Tell the class that each pair of students will receive one ice cube. They must keep the ice cubes in solid form as long as possible. The students may use any materials found in the classroom as insulation, or you may provide students an opportunity to bring items from home. Do not allow manufactured coolers, thermos, etc.
2. Allow a few minutes for organization and collection of materials.
3. Distribute one ice cube to each pair of students and tell them that their task is to make the ice cube last as long as possible (using materials they collected as "insulation"). Keep track of time, to determine how long the ice cubes last.
4. Once all the cubes are melted, the students will meet as one large group to discuss the varied materials used for insulation. The teacher will chart this information on the chalkboard. Discuss with students how insulation conserves energy, e.g., in air conditioning of homes, refrigeration, etc.
5. Have the teams write up two or three plans for insulating an ice cube. Encourage them to test the effectiveness of their plans. Have students graph how long their ice cubes lasted using the different insulation plans.

Suggested Career Awareness Activity
Have the students identify occupations created by changes in energy conservation technology.

Suggested Assessment
List three materials that could be used effectively as insulation, and describe how they conserve energy.

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